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AIRMAN'S INFORMATION MANUAL

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FEDERAL AVIATION AGENCY

Air Traffic Service
Flight Information Division

AIRMAN'S INFORMATION MANUAL

INTRODUCTION

This Airman's Information Manual (AIM) has been developed by the Federal Aviation Agency as a pilot's operational manual replacing the Airman's Guide, Directory of Airports and Seaplane Bases, and the Flight Information Manual within the conterminous United States. The existing Alaska Airman's Guide and Chart Supplement and the Pacific Airman's Guide and Chart Supplement will continue to be published every 28 days.

The new AIM presents, in a single document, all information necessary for the planning and conduct of a flight in the National Airspace System. The content and format reflect user identified requirements and provide a "one package" approach.

The manual is divided into six sections, each composed of a specific category or family of information, fashioned into a format consistent with the operational needs of aviation. In contradistinction to previous flight information publications issued by FAA, the design concept of the AIM has provided for consolidation of similar information, segregation of air traffic control procedural information and its sequencing according to operational use, and the elimination of administrative and non-essential data.

The AIM is designed to be carried in the cockpit and may be used collectively or independently by sections. The manual is published as loose-leaf pages, and is three-hole punched to fit a standard three-ring binder.

New or amended textual or tabulated information except in the Airport/Facility Directory, is indicated by a solid dot ● prefixing the heading, paragraph, or line.

Each section of the AIM will be published at varying intervals during the year, depending on the stability or frequency or change of the information.

The various sections and the revision cycle of each are:

Section I	Basic Flight Manual	Semi-annually
Section II	ATC Operations and Procedures	Quarterly
Section III	Flight Data and Special Operations	Every 28 days
Section III–A	Notices to Airmen	Every 14 days
Section IV	Airport Directory	Semi-annually
Section IV–A	Airport/Facility Directory	Every 28 days

The above schedule provides a completely new manual every 6 months.

The revision cycle of Sections III and IV–A is every 28 days, the same as the IFR Enroute charts. Since the charts contains basically enroute information, the AIM serves as a supplementary publication, providing information for planning and terminal operations. Every effort has been made to minimize and eliminate duplication of information within publications and between publications and charts.

A brief description of the contents of each section in the AIM follows.

Section I—Basic Flight Manual

This section contains information of an instructional, educational, and training nature, assembled and presented in a systematic format, categorized by subject matter. The novice pilot, as well as the more experienced pilot will find here the basic fundamentals of knowledge for operating in the National Airspace System, information on adverse factors affecting safety of flight and health, and a list of available publications of general operational interest.

Section II—ATC Operations and Procedures

• Section II is designed to serve as an official means of disseminating pertinent ATC information of interest to all pilots. The information governing flight operations, air traffic services, and procedures is presented in layman's language and avoids ambiguities which often result from individual interpretations of rules. Data is sequenced in accordance with typical flight operations. A glossary or explanation of aeronautical term or phrases used in the AIM, preflight, departure, enroute, arrival and landing procedures. In addition, supporting general procedures and information such as ADIZ, and SCATER procedures is included. Emergency procedures are combined and published at the end of the section.

Section III—Flight Data and Special Operations

Operational data most subject to change and which is not appropriate for inclusion within other sections of the AIM is carried in Section III. Because it contains critical flight data most subject to change, this section should be kept close at hand in the event of a divergence in enroute flight. Some of the most significant material contained in Section III is described below.

• A list of commonly used abbreviations; list of new and permanently closed airports.

Special Notices of pertinent current information of operational value for both preflight planning and enroute operations. These Special Notices are divided into two categories: General Notices—those of a general nature with universal application; Area Notices—those pertinent to a specific geographical area.

A Sectional Chart Bulletin, as a means of updating the Sectional Charts, providing a cumulative tabulation of the major changes in aeronautical information occurring since the last chart publication date.

Detailed description tabulations and charts of Special Operations such as Oil Burner Routes and military refueling tracks.

Section III—A—Notices to Airmen

Section III–A serves as a supplement, issued every fourteen days, to the AIM and provides operationally required data pertinent to the continuous NOTAMs carried in the daily teletypewriter NOTAM Summary (NOSUM), revisions to Oil Burner routes, and those airman advisories deemed essential to the safe conduct of flight.

Section IV—Airport Directory

Section IV tabulates by State and City name all civil airports, seaplane bases and heliports, *without communications*, in the conterminous United States which are open to the general aviation public and includes all of their facilities and services.

Airports with communications are listed separately in Section IV–A but are cross referenced in this tabulation.

This section also contains a listing of selected commercial broadcast stations of 100 watts or more power.

Section IV–A—Airport/Facility Directory

Section IV–A contains a listing of all major airfields which have radio communications and terminal navigational aids available, and combines the facilities and services at each field. These airfields are also cross referenced in Section IV.

• Included in this section is a tabulation of all Air Navigation Radio Aids in the National Airspace System and those upon which the FAA has approved an instrument approach. Private or military Navigation Radio Aids not in the National Airspace System are not tabulated.

Also included in this section is a listing of ARTCC Civil Communications frequencies, a tabulation of Flight Service Stations and Weather Bureau Telephone Numbers and a Master Alphabetical Index of the AIM. The index lists all items of information, cross referenced under all headings to which reference might reasonably be made, giving section and page number. Within the index, any reference involving emergency actions or procedures is printed in bold-face type.

Errors, Omissions, or Suggested Changes

Errors, omissions, or suggested changes should be forwarded to the Federal Aviation Agency, Air Traffic Service, Attention AT–600, Washington, D.C. 20553. Airport managers, operators and owners are urged to review data for their airport and report any errors or omissions to FAA at the address given above.

Procurement

The Airman's Information Manual is available from the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402. Orders should be accompanied by check or money order made payable to the Superintendent of Documents.

AIRMAN'S INFORMATION MANUAL

BASIC FLIGHT MANUAL

SECTION I

EFFECTIVE **DECEMBER 1965**

To **MAY 1966**

FEDERAL AVIATION AGENCY

INTRODUCTION

Section I—BASIC FLIGHT MANUAL

Section I, Basic Flight Manual, contains, in layman's language, educational, instructional and training information. This information is assembled and presented in a systematic format, categorized by subject matter, providing the novice pilot, as well as the more experienced pilot, with the information to orient or update himself on the basic fundamentals of aeronautical knowledge required to fly in the National Airspace System. The Basic Flight Manual serves as an official medium for documentation and interpretation of aeronautical knowledge for the general aviation pilot.

In addition to the above type of information, adverse factors affecting the safe operation of an aircraft, either on the ground or in the air, and health and medical facts of interest to the pilot are presented.

The section concludes with a list of supplementary aeronautical publications of general operational interest to pilots, providing the latest publication date, the cost and where they may be obtained.

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BASIC FLIGHT MANUAL

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Section I—BASIC FLIGHT MANUAL

GOOD OPERATING PRACTICES

It should be remembered that adherence to air traffic rules does not eliminate the need for good judgment on the part of the pilot. Compliance with the following Good Operating Practices will greatly enhance the safety of every flight.

Alertness

Be alert at all times, especially when the weather is good. Most pilots pay attention to business when they are operating in full IFR weather conditions, but strangely, air collisions almost invariably have occurred under ideal weather conditions. Unlimited visibility appears to encourage a sense of security which is not at all justified.

Judgment in VFR Flight

Use reasonable restraint in exercising the prerogative of VFR flight, especially in terminal areas. The weather minimums and distances from clouds are minimums. Giving yourself a greater margin in specific instances is just good judgment.

Conducting a VFR operation in a Control Zone when the official visibility is 3 or 4 miles is not prohibited, but good judgment would dictate that you keep out of the approach area.

It has always been recognized that precipitation reduces forward visibility. Consequently, although again it may be perfectly legal to cancel your IFR flight plan at any time you can proceed VFR, it is good practice, when precipitation is occuring, to continue IFR operation into a terminal area until you are reasonably close to your destination.

In conducting simulated instrument flights, be sure that the weather is good enough to compensate for the restricted visibility of the safety pilot or your greater concentration on your flight instruments. Give yourself a little greater margin when your flight plan lies in or near a busy airway or close to an airport.

Giving Way

If you think another aircraft is too close to you, give way instead of waiting for the other pilot to respect the right-of-way to which you may be entitled. It is a lot safer to pursue the right-of-way angle after you have completed your flight.

Use the Federal Airways

The establishment of the Federal Airways system costs the Government millions of dollars annually. The operation and maintenance of the system costs additional millions every year. Sure, you can stay off the airways most of the time during certain flights by electing to fly "direct" but why ignore the additional safety available in controlled airways?

Use of Victor Airways

Pilots not operating on an IFR flight plan, and when in level cruising flight, are cautioned to conform with VFR cruising altitudes appropriate to direction of flight. During climb or descent, pilots are encouraged to fly to the right side of the center line of the radial forming the airway in order to avoid IFR and VFR cruising traffic operating along the center line of the airway.

Traffic Patterns

At most airports and military air bases, traffic pattern altitudes for propeller driven aircraft generally extend from 600 feet to as high as 1500 feet above the ground. Also traffic pattern altitudes for military turbojet aircraft sometimes extend up to 2000 feet above the ground. Therefore, pilots of en route aircraft should be constantly on the alert for other aircraft in traffic patterns and avoid these areas whenever possible.

Follow IFR Procedures Even When Operating VFR

You don't have to follow IFR procedures if you are conducting VFR operations, but you cannot maintain instrument proficiency without practicing at every opportunity. Use all the navigational aids available and make accurate position reports.

Report

On a VFR flight, when making initial radio contact with a control tower or a Flight Service Station providing Airport Advisory Service, report position and altitude. This will make it easier for ground facility personnel and other pilots to locate your aircraft.

Record ATC Clearance

When conducting an IFR operation, make a written record of your ATC clearance. The specified conditions which are a part of your air traffic clearance may be somewhat different from those included in your flight plan. Additionally, Air Traffic Control may find it necessary to ADD conditions, such as a particular departure

Record ATC Clearance (Con't)

route. The very fact that Air Traffic Control specifies different or additional conditions means that other aircraft are involved in the traffic situation.

Recognize Equipment Capabilities

Until planned receiving equipment can be installed at remote VOR transmitting sites, pilots should remember that while they may be hearing the station "loud and clear" through the voice facility of the VOR to which they are tuned, the receivers being used by the station they are calling may be some distance away, rather than at the transmitter site. In the case of flights conducted at fairly low altitudes, this may make it difficult for the station to receive signals from the aircraft and should be taken into account when trying to establish two-way communication.

Use Proper Frequency Channels

When asking for weather reports and other flight information, ask that the station transmit such information on the voice channel of a navigation aid. This will assist in alleviating the congestion on standard communications frequencies.

•Decrease Frequency Congestion

At busy terminal airports where current procedures do not require that initial radio call by ALL inbound aircraft be made on the appropriate approach control frequency, the pilot, by adopting the following practice, will decrease frequency congestion and thereby increase safety: monitor the tower local frequency for a sufficient length of time prior to reaching normal call-up point to determine wind and runway information. When initial call is made to tower the following information will suffice—identification, position, and the fact that wind and runway information has been received—the term "have numbers" or a similar phrase should be used by the pilot for this purpose. Additionally, if appropriate VFR reporting point for the runway in use is known, advise tower you will report over that point. Pilots are also requested to check the information under the heading Automatic Terminal Information Service (ATIS) in Sections II and IVA.

•Communications With Tower When Aircraft Transmitter/Receiver Or Both Are Inoperative (See Federal Aviation Regulations, Part 91, Sections 91.87 and 91.77).

1. Arrival

a. Receiver inoperative—If you have reason to believe your receiver is inoperative, advise the tower of your type aircraft, position, altitude, intention to land and request that you be controlled with light signals. (The color, type, and meanings of light signals are published in FAR 91.77 and the AIM, Section II). When you are approximately 3 to 5 miles from the airport, advise the tower of your position and join the airport traffic pattern. From this point on, watch the tower for light signals. Thereafter, if a complete pattern is made, transmit your position when downwind and/or turning base leg.

b. Transmitter inoperative—Join the airport traffic pattern. Monitor the primary local control frequency as depicted on Sectional Charts for landing or traffic information, and look for a light signal which may be addressed to your aircraft. During hours of daylight, acknowledge tower transmissions or light signals by rocking your wings. At night, acknowledge by blinking the landing or navigation lights.

c. Transmitter and receiver inoperative—Join the airport traffic pattern and maintain visual contact with the tower to receive light signals. Acknowledge light signals in accordance with 1.b. above.

2. Departures.

If you experience radio failure prior to leaving the parking area, make every effort to have the equipment repaired. If you are unable to have the malfunction repaired, call the tower by telephone and request authorization to depart without two-way radio communications. If tower authorization is granted, you will be given departure information and requested to monitor the tower frequency or watch for light signals, as appropriate. During daylight hours, acknowledge tower transmissions or light signals by moving the ailerons or rudder. At night, acknowledge by blinking the landing or navigation lights. If radio malfunction occurs after departing the parking area, watch the tower for light signals or monitor tower frequency.

Communications Guard on VFR Flights

On VFR flights, guard the voice channel of VORs for broadcasts and calls from FAA Flight Service Stations.

Avoid Flight Beneath Unmanned Balloons

The majority of unmanned free balloons currently being operated have, extending below them, either a suspension device to which the payload or instrument package is attached, or a trailing wire antenna, or both. In many instances these balloon subsystems may be invisible to the pilot until his aircraft is close to the balloon, thereby creating a potentially dangerous situation. Therefore, good judgment on the part of the pilot dictates that aircraft should remain well clear of all unmanned free balloons and flight below them should be avoided at all times.

Student Pilots Radio Identification

The FAA desires to help the student pilot in acquiring sufficient practical experience in the environment in which he will be required to operate. To receive additional assistance while operating in areas of concentrated air traffic, a student pilot need only identify himself as a student pilot during his initial call to an FAA radio facility. For instance, "Dayton Tower, this is Fleetwing 1234, Student Pilot, over." This special identification will alert FAA air traffic control personnel and enable them to provide the student pilot with such extra assistance or consideration as he may need. This procedure is not mandatory.

Conformance with the above Good Operating Practices is not as simple as it sounds. It requires constant attention to innumerable details and a deep-seated realization that additional hazards incident to flight operations exist whenever vigilance is relaxed.

AIR NAVIGATION RADIO AIDS

GENERAL

Various types of air navigation aids are in use today, each serving a special purpose in our system of air navigation.

These aids have varied owners and operators namely: the Federal Aviation Agency, the military services, private organizations; and individual states and foreign governments.

The Federal Aviation Agency has statutory responsibility for the operation and maintenance of any of these aids which are, in whole or in part, used by the general public for air navigation in federally controlled airspace.

LOW/MEDIUM FREQUENCY (L/MF) RADIO RANGE

1. These ranges are classified by their type of antenna and power. Two types of low-frequency ranges are in use: Loop range (L) and Adcock range (A). Their normal power output is divided into three power classifications.

Over 150 watts (R)
50 to 150 watts (MR)
Under 50 watts (M)

2. It is a popular misconception that loop ranges should not be used for homing. The dual-frequency or "simultaneous" type loop range transmits a nondirectional signal that can be used quite satisfactorily for this purpose.

3. Low-frequency radio range courses are subject to disturbances that result in multiple courses, signal fades and surges over rough country. Pilots flying over unfamiliar routes are cautioned to be on the alert to detect these vagaries, particularly over mountainous terrain.

4. In the near future, all but approximately 87 of the L/MF radio ranges will be decommissioned. Those remaining will be converted to nondirectional radio beacons.

RADIO BEACON

1. A low or medium-frequency radio beacon transmits nondirectional signals whereby the pilot of an aircraft equipped with a loop antenna can determine his bearing and "home" on the station. These facilities normally operate in the frequency band of 200 to 415 kc and transmit a continuous carrier with 1,020-cycle modulation keyed to provide identification except during voice transmission.

2. The operational purpose for which the facility is installed generally determines the power output and the name classification. The facilities are classified as follows:

Compass Locators: Power output less than 25 watts. (15 miles)

MH Facility: Power output less than 50 watts. (25 miles)

H Facility: Power output greater than 50 watts but less than 2,000 watts. (50 miles)

HH Facility: Power output greater than 2,000 watts. (75 miles)

3. When a LF nondirectional homing beacon is used in conjunction with the Instrument Landing System markers, it is called a Compass Locator.

4. All radio beacons except the compass locators transmit a continuous three-letter identification in code except during voice transmissions. Compass locators transmit a continuous two-letter identification in code. The first and second letters of the three-letter location identifier are assigned to the front course outer marker compass locator (LOM), and the second and thrid letters are assigned to the front course middle marker compass locator (LMM).

Example:

ATLANTA, ATL, LOM-AT, LMM-TL.

5. Voice transmissions are made on radio beacons unless the letter "W" (without voice) is included in the class designator (HW).

VHF OMNIDIRECTIONAL RANGE (VOR)

1. Omniranges operate within the 108–118 mc frequency band and have a power output of aproximately 200 watts. The equipment is VHF, thus, it is subject to line-of-sight restriction, and its range varies proportionally to the altitude of the receiving equipment. There is some "spill over," however, and reception at an altitude of 1000 feet is about 40 to 45 miles. This distance increases with altitude.

2. There is voice transmission on the VOR frequency and all information broadcast over L/MF ranges is also available over the VOR's.

3. The effectiveness of the VOR depends upon proper use and adjustment of both ground and airborne equipment.

a. **Accuracy:** The accuracy of course alignment of the VOR is excellent, being generally plus or minus 1°.

b. **Roughness:** On some VORs, minor course roughness may be observed, evidenced by course needle or brief flag alarm activity (some receivers are more subjct to these irregularities than others). At a few stations, usually in mountainous terrain, the pilot may occasionally observe a brief course needle oscillation, similar to the indication of "approaching station." Pilots flying over unfamiliar routes are cautioned to be on the alert for these vagaries, and in particular, to use the "to-from" indicator to determine positive station passage.

(1) Certain propeller RPM settings can cause the VOR Course Deviation Indicator to fluctuate as much as ±6°. Slight changes to the RPM setting will normally smooth out this roughness. Helicopter rotor speeds may also cause VOR course disturbances. Pilots are urged to check for this propeller modulation phenomenon prior to reporting a VOR station or aircraft equipment for unsatisfactory operation.

4. The only positive method of identifying a VOR is by its Morse Code identification or by the recorded automatic voice identification which is always indicated

VHF OMNIDIRECTIONAL RANGE (VOR) (Con't)

by use of the word "VOR" following the range's name. Reliance on determining the identification of an omnirange should never be placed on listening to voice transmissions by the Flight Service Station (FSS) (or approach control facility) involved. Many FSS remotely operate several omniranges which have different names from each other and in some cases none have the name of the "parent" FSS. (During periods of maintenance the coded identification is removed. See MAINTENANCE OF FAA NAVAIDS.)

5. Voice identification has been added to numerous VHF omniranges. The transmission consists of a voice announcement, "AIRVILLE VOR" (VORTAC) alternating with the usual Morse Code identification. If no air/ground communications facility is associated with the omnirange, "AIRVILLE UNATTENDED VOR" (VORTAC) will be heard.

VOR RECEIVER CHECK

1. Part 91.25 of the Federal Aviation Regulations provides for certain VOR equipment accuracy checks prior to flight under instrument flight rules. To comply with this requirement and to ensure satisfactory operation of the airborne system, the FAA has provided pilots with the following means of checking VOR receiver accuracy: (1) VOR test facility (VOT), (2) certified airborne check points, and (3) certified check points on the airport surface.

a. The VOR test facility (VOT) transmits a test signal for VOR receivers which provides users of VOR a convenient and accurate means to determine the operational status of their receivers. The facility is designed to provide a means of checking the accuracy of a VOR receiver while the aircraft is on the ground. The radiated test signal is used by tuning the receiver to the published frequency of the test facility. With the Flight Path Deviation Indicator (FPDI) centered the omnibearing selector should read 0° with the to-from indication being "from" or the omnibearing selector should read 180° with the to-from indication reading "to." Should the VOR receiver be of the automatic indicating type, the indication should be 180°. Two means of identification are used with the VOR radiated test signal. In some cases a continuous series of dots is used while in others a continuous 1020 cycletone will identify the test signal. Information concerning an individual test signal can be obtained from the local Flight Service Station.

b. Airborne and ground check points consist of certified radials that should be received at specific points on the airport surface, or over specific landmarks while airborne in the immediate vicinity of the airport.

c. Should an error in excess of ±4° be indicated through use of the ground check, or ±6° using the airborne check, IFR flight shall not be attempted without first correcting the source of the error. CAUTION: no correction other than the "correction card" figures supplied by the manufacturer should be applied in making these VOR receiver checks.

d. The list of airborne check points and ground check points is published in Section III. VOT's are included with the airport information in Section IV A.

TACTICAL AIR NAVIGATION (TACAN)

1. For reasons peculiar to military or naval operations (unusual siting conditions, the pitching and rolling of a naval vessel, etc.) the civil VOR-DME system of air navigation was considered unsuitable for military or naval use. A new navigational system, Tactical Air Navigation (TACAN), was therefore developed by the military and naval forces to more readily lend itself to military and naval requirements. As a result, the FAA has been in the process of integrating TACAN facilities with the civil VOR-DME program. Although the theoretical, or technical principles of operation of TACAN equipment are quite different from those of VOR-DME facilities, the end result, as far as the navigating pilot is concerned, is the same. These integrated facilities are called VORTAC's.

2. TACAN ground equipment consists of either a fixed or mobile transmitting unit. The airborne unit in conjunction with the ground unit reduces the transmitted signal to a visual presentation of both azimuth and distance information. TACAN is a pulse system and operates in the UHF band of frequencies. Its use requires TACAN airborne equipment and does not operate through conventional VOR equipment.

VHF OMNIDIRECTIONAL RANGE/TACTICAL AIR NAVIGATION (VORTAC)

1. VORTAC is a facility consisting of two components, VOR and TACAN, which provides three individual services: VOR azimuth, TACAN azimuth and TACAN distance (DME) at one site. Although consisting of more than one component, incorporating more than one operating frequency, and using more than one antenna system, a VORTAC is considered to be a unified navigational aid. Both components of a VORTAC are envisioned as operating simultaneously and providing the three services at all times.

2. Transmitted signals of VOR and TACAN are each identified by three-letter code transmission and are interlocked so that pilots using VOR azimuth with TACAN distance can be assured that both signals being received are definitely from the same ground station. A supplementary automatic voice identification is being added to the VOR. The frequency channels of the VOR and the TACAN at each VORTAC facility are "paired" in accordance with a national plan to simplify airborne operation.

DISTANCE MEASURING EQUIPMENT (DME)

1. In the operation of DME, paired pulses at a specific spacing are sent out from the aircraft (this is the interrogation) and are received at the ground station. The ground station (transponder) then transmits paired pulses back to the aircraft at a different pulse spacing and on a different frequency. The time required for the round trip of this signal exchange is measured in the airborne DME unit and is translated into distance (Nautical Miles) from the aircraft to the ground station.

2. Operating on the line-of-sight principle, DME furnishes distance information with a very high degree of accuracy. Reliable signals may be received at distances up to 199 NM at line-of-sight altitude with an accuracy of better than ¼ mile or 2% of the distance, whichever is greater. Distance information received from DME equipment is SLANT RANGE distance and not actual distance. Distance information received is therefore, a function of altitude.

3. DME operates on frequencies in the UHF spectrum between 962 mc and 1213 mc. Aircraft equipped with TACAN equipment will receive distance information from

DISTANCE MEASURING EQUIPMENT (DME) (Con't)

a VORTAC automatically, while aircraft equipped with VOR must must have a separate DME airborne unit.

4. VOR/DME and VORTAC navigation facilities established by the FAA provide azimuth and distance information from co-located components under a frequency pairing plan. Frequency pairing allows the use of a single receiver tuning selector capable of simultaneously selecting a paired VOR and TACAN (DME) receiver frequency.

5. Due to the limited number of available frequencies, assignment of frequency pairs has been required for certain military noncollocated VOR and TACAN facilities which serve the same area but which may be separated from a few to many miles. Additional frequency assignments have been made for remotely located military TACAN facilities which may be within reception range of a randomly paired ILS localizer. Selection of a DME channel while tuned to a randomly paired VOR or ILS frequency could result in the reception of distance information from a source which is remotely located from the VOR or ILS facility.

6. VOR/DME, VORTAC and ILS/DME facilities are readily identified by synchronized identifications which are transmitted on a time share basis. Identification of noncollocated VOR or ILS and TACAN facilities are not synchronized, resulting in intermixing and apparent distortion during TACAN identification whenever simultaneous aural monitoring of VOR or ILS and TACAN identification is attempted. DME equipment has been installed at only a few ILS locations and any DME presentation while using an ILS frequency which does not have an associated DME would be originating from a randomly paired remote location.

7. Aircraft receiving equipment which provides for automatic DME selection assures reception of azimuth and distance information from a common source whenever designated VOR/DME, VORTAC and ILS/DME navigation facilities are selected. Until further advised, pilots are cautioned to disregard any distance displays from automatically selected DME equipment whenever VOR or ILS facilities, which do not have the DME feature installed, are being used for position determination.

OPERATIONAL LIMITATIONS VOR/VORTAC/TACAN

1. The terms VOR, VORTAC, and TACAN are, operationally, general terms covering the VHF and UHF omnidirectional bearing type of facilities without regard to the fact that the power, the frequency protected area, the equipment configuration, and operational requirements may vary between the facilities at different locations.

2. The table below lists the intended operational service volume or volumes of the various categories of VOR's VORTAC's, and TACAN's. Below 18,000 feet msl, the operational service volume of the H class facility has been limited to the L class service volume due to signal coverage characteristics of VHF and UHF facilities at the lower altitudes. T class facilities provide terminal service at locations where it is not practicable to provide L class frequency protection. Normal signal coverage and interference free service may be expected within the operational service volume unless specific facility restrictions have been imposed. Except along established airways or routes, use of these facilities for IFR operations outside of the operational service volume without additional flight inspection is not intended and may result in undependable or inadequate indications in the cockpit.

Class of VOR, VORTAC, or TACAN	Operational Service Volume
T (Terminal)	25 nmi up to 12,000′ msl
L (Low altitude)	40 nmi up to 18,000′ msl
H (High altitude)	40 nmi up to 18,000′ msl 130 nmi from 18,000′ msl to 45,000′ msl 100 nmi above 45,000′ msl

FREQUENCY PAIRING PLAN

VOR—ILS (even) (odd) Frequency	TACAN Channel	VOR Frequency	TACAN Channel
108.0 mc.	17	112.0 mc.	57
108.1	18	112.1	[illegible]
108.2	19	112.2	[illegible]
108.3	20	112.3	70
108.4	21	112.4	71
108.5	22	112.5	72
108.6	23	112.6	73
108.7	24	112.7	74
108.8	25	112.8	75
108.9	26	112.9	76
109.0	27	113.0	77
109.1	28	113.1	78
109.2	29	113.2	79
109.3	30	113.3	80
109.4	31	113.4	81
109.5	32	113.5	82
109.6	33	113.6	83
109.7	34	113.7	84
109.8	35	113.8	85
109.9	36	113.9	86
110.0	37	114.0	87
110.1	38	114.1	88
110.2	39	114.2	89
110.3	40	114.3	90
110.4	41	114.4	91
110.5	42	114.5	92
110.6	43	114.6	93
110.7	44	114.7	94
110.8	45	114.8	95
110.9	46	114.9	96
111.0	47	115.0	97
111.1	48	115.1	98
111.2	49	115.2	99
111.3	50	115.3	100
111.4	51	115.4	101
111.5	52	115.5	102
111.6	53	115.6	103
111.7	54	115.7	104
111.8	55	115.8	105
111.9	56	115.9	106
	(Continued)		(Continued)

:on't)

VOR Frequency	TACAN Channel
116.0	107
116.1	108
116.2	109
116.3	110
116.4	111
116.5	112
116.6	113
116.7	114
116.8	115
116.9	116
117.0	117
117.1	118
117.2	119
117.3	120
117.4	121
117.5	122
117.6	123
117.7	124
117.8	125
117.9	126

ı assigned to ILS localizer fre-
: for programmed ILS/DME in-

BEACON

to identify a particular loca-
'ay or on the approach to an
:s done by means of a 75-mc
s a directional signal to be
overhead. These markers are
n with Low Frequency Radio
ıt Landing System as point
f markers are now in general
ation or Z-Markers, and the

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they are located. The radio
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' near north) course being
:rs located on course number
: dashes, those on course two,
an markers are located on the
ıe identification of the outer
: two dots; thus the identifi-
rker on a number one course

rkers are used to provide a
:itions at definite points along
ters have a power output of
Two types of antenna array
markers. The first type used,
s the standard type, produces
ı, which at an elevation of
ls about four miles wide and
:t the pattern widens to about
:s long. (The long axis lies
range.)

4. The second array produces a dumbbell or boneshaped pattern, which, at the "handle" is about three miles wide at 1000 feet. The boneshaped marker is preferred at approach control locations where "timed" approaches are used.

5. The class LFM or low-powered fan markers have a rated power output of 5 watts and are usually located within 5 miles of the radio range stations with which they are associated. The antenna array produces a circular pattern which appears elongated at right angles to the airway due to the directional characteristics of the aircraft receiving antenna.

6. The Station Location, or Z-Marker, was developed to meet the need for a positive position indicator for aircraft operating under instrument flying conditions to show the pilot when he was passing directly over a Low Frequency Radio Range Station. The marker consists of a 5-watt transmitter and a directional antenna array which is located on the range plot between the towers or the loop antennas.

7. ILS marker beacon information is included under "ILS."

INSTRUMENT LANDING SYSTEM (ILS)

1. GENERAL

a. The instrument landing system is designed to provide an approach path for exact alignment and descent of an aircraft on final approach to a runway.

b. The ground equipment consists of two highly directional transmitting systems and, along the approach, three (or fewer) marker beacons. The directional transmitters are known as the localizer and glide path transmitters

c. The system may be divided functionally into three parts:

Localizer—course information
Glide Path—descent information
Marker beacons—range information

d. Compass Locators and Approach Light Lanes supplement these major components.

2. LOCALIZER

a. The localizer transmitter, located at the far end of the runway, transmits signals which enable the pilot to steer the required course to the runway. The transmitter, operating on one of twenty channels within the range of 108.1 mc to 111.9 mc, emits two patterns, one modulated at 150, and the other at 90 cycles per second. These two signal patterns overlap along a line formed by an elongation of the runway. The aircraft receiving equipment finds this line by finding the area of equal signal strength between the two patterns, just as the course of a radio range is the area of equal strength between two quadrants. The course width of the localizer signal is set between 4 to 6° depending on the length and tailored to provide a constant width of 700 feet at the runway threshold. At a distance of 10 miles the width of the signal is approximately one mile.

b. For the purpose of reference, the 150-cycle area to the right of the approaching aircraft is called the Blue area, and the 90-cycle area to the left of the approaching aircraft is called the Yellow area. The approach course of the localizer is called the front course.

c. The course along the centerline of the runway in the opposite direction is called the back course. The localizer transmitter has a range of approximately 40 miles at an altitude of 5,000 feet, and 80 miles at 10,000 feet. It can carry voice transmissions.

INSTRUMENT LANDING SYSTEMS (Con't)

d. Identification consists of three-letter signals preceded by an I(..) transmitted on the localizer frequency.

3. GLIDE PATH

a. The UHF glide path transmitter is located between 750 feet and 1,250 feet from the approach end of the runway and offset 400 feet to 600 feet from the runway centerline. It transmits a glide path beam 1.4° wide.

b. The glide path transmitter radiates its signals principally in the direction of the final approach, and although some radiation is in the reverse direction, it is not usable. The glide path transmitter, operating on one of 20 channels, transmits patterns modulated at 90 cycles and 150 cycles. The location of the glide path is determined by finding the area of equal signal strength between the patterns.

c. The glide path projection angle is normally adjusted to 2.5 degrees to 3 degrees above horizontal so that it intersects the middle marker at about 200 feet and the outer marker at about 1400 feet above the runway elevation.

d. In addition to the desired path, false course, reversal in sensing, will occur at vertical angles considerably greater than the usable path.

Example:

For a glide angle setting of 3 degrees, null reference equipment has a false course 9 degrees above horizontal. Nulls also occur above the path which cause the needle to center and the flag to show, indicating the absence of signal.

e. The proper use of the glide path requires that the pilot maintain alertness as the glide path intersection is approached and interpret correctly the "fly-up" and "fly-down" instrument indications to avoid the possibility of attempting to follow one of the higher angle courses.

f. Provided that procedures are correctly followed and pilots are properly indoctrinated in glide path instrumentation, the fact that these high angle courses exist should cause no difficulty in the glide path navigation since they will not normally be encountered.

g. Extreme caution should be used when flying the glide path where the indicator shows the position of the aircraft to be under the glide path. The suggested limits are not to exceed three dot deviation up to the middle marker and to allow no "fly-up" condition from the middle marker to completion of landing.

h. FAA glide slope facilities are intended to provide reliable glide slope signals for use in conjunction with the front course of the ILS localizer. Glide slope signals may be received in other azimuths (because of stray radiation from the antennas and reflections from nearby objects) which may in some cases be sufficient to activate the airborne warning flag. Any glide slope needle activity in these other azimuths should be disregarded.

i. Pilots are particularly cautioned to ignore glide slope indications when making back course localizer approaches. All FAA approved procedures for back course approaches are limited to use of the localizer portion of the ILS. Any attempt to fly spurious glide slope indications on such back course approaches could result in hazardous operations.

j. Null reference glide slope facilities provide a signal which flares at about thirty (30) feet above the runway. Caution is advised on automatic approaches continued past runway threshold.

4. MARKER BEACON

a. There are ordinarily two marker beacons, the outer and middle, but there are exceptions at some locations. Frequently the Z-marker of a radio range station located along the localizer beam serves as the outer marker in place of the regular fan-type marker.

b. The outer marker is approximately 4 to 7 miles from the approach end of the runway and within 250 feet of an extended center line of the runway. Its signal is keyed at two dashes per second.

c. The middle marker is located 3500 feet plus or minus 250 feet from the runway and within 50 feet of the center line extended. It transmits a series of alternate dots and dashes.

5. COMPASS LOCATOR

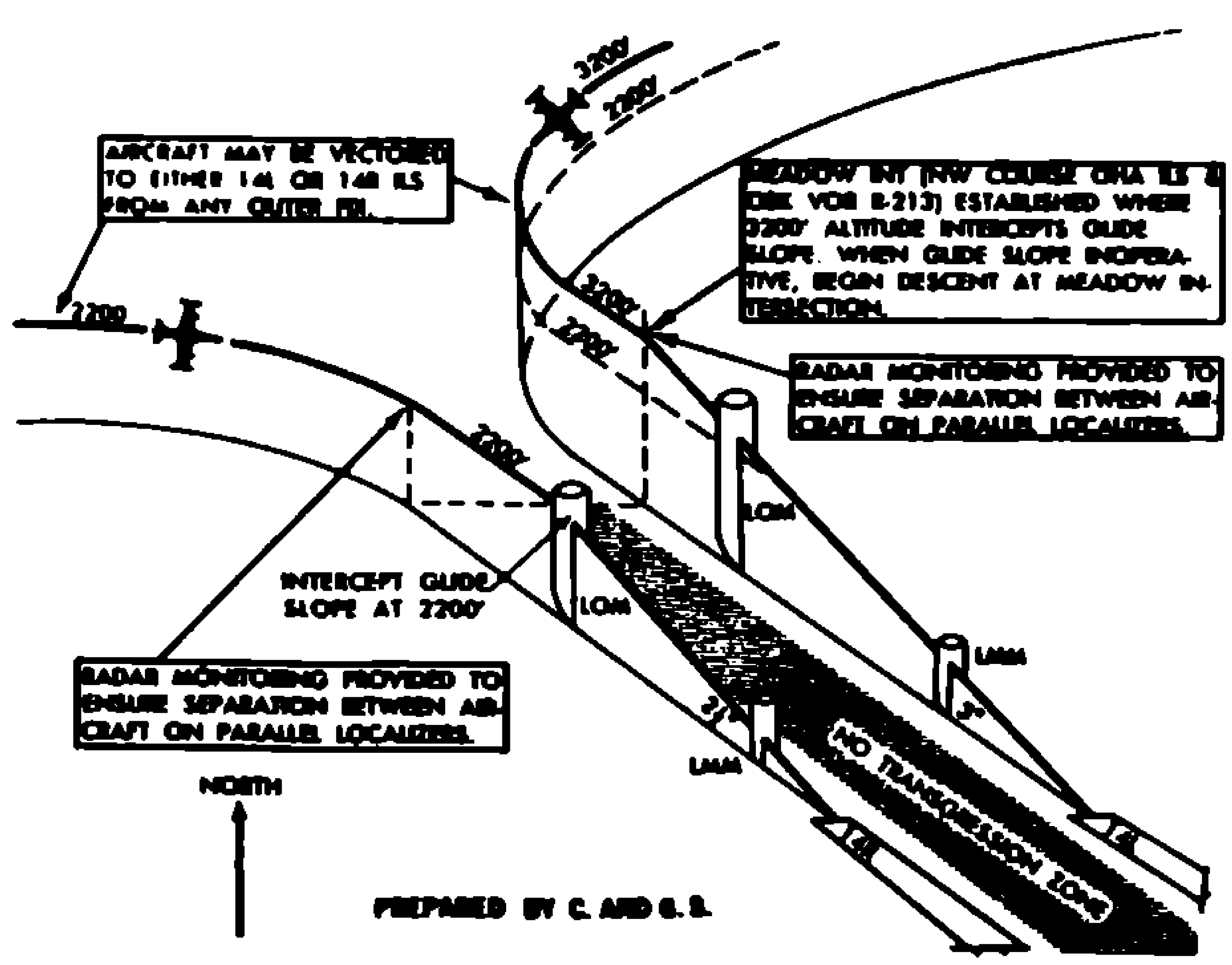
• a. Compass locator transmitters are often situated at the middle and outer marker sites. The transmitters have a power output of 25 watts, a range of 50 miles, and operate between 200 and 415 kc.

b. Compass locators transmit two-letter identification groups. The outer locator transmits the first two letters of the localizer identification group, and the middle locator transmits the last two letters of the localizer identification group.

6. PARALLEL ILS APPROACHES

a. *System:* An approach system permitting simultaneous parallel approaches has been adopted for airports having parallel runways with minimum spacing of 5,000 feet between centerlines. Integral parts of a total system are ILS, radar, communications, ATC procedures, and flight procedures. When advised that PARALLEL ILS APPROACHES ARE IN PROGRESS pilots who do not have the required equipment (stated on the instrument approach chart) or who do not wish to conduct a parallel ILS approach or require a specific runway must advise approach control prior to departing the outer fix.

b. *Radar Monitor Service:* This service is provided for each ILS to insure prescribed lateral separation during approaches. Pilots will be assigned frequencies to receive advisories and instructions. This may include the mon-



(See paragraph c. next page)

INSTRUMENT LANDING SYSTEMS (Con't)

itoring of the ILS localizer frequency. Aircraft deviating by 1,500 feet from either localizer to the point where the no transgression zone (an area at least 2,000 feet wide) may be penetrated will be instructed to take corrective action. If an aircraft fails to respond to such instruction, the aircraft on the adjacent localizer may be instructed to alter course.

c. **Chicago—O'Hare Airport:** This is the first, and at present the only, airport where these approaches have been authorized. Pilots planning to land at Chicago O'Hare Airport should be thoroughly familiar with the procedures contained on the parallel ILS approach chart. The graphic portrayal of the system in use for runways 14L/R at Chicago is shown on the previous page. Parallel ILS approaches may also be conducted to runways 32L/R. For complete details, refer to the appropriate Instrument Approach Procedure.

7. ILS MINIMA

a. ILS minima with all components operative are usually 200–½. Minima of 300–¾ may be authorized with any one component inoperative except the localizer. If 300 feet of obstruction clearance in the approach area cannot be provided with the glide slope inoperative, a note indicating the minima which does provide 300 feet obstruction clearance will be added to the approach chart.

Example:

"400–¾ required with glide slope inop."

b. Straight-in minima of 300–1 are authorized with only the outer marker and localizer operative if 300 feet of obstruction clearance is provided in the approach area.

c. Circling minima are authorized with only the localizer and the outer marker operative.

8. ILS CHANNEL/FREQUENCY

a. ILSs are being commissioned utilizing all 20 channels allotted to ILS by ICAO in Aeronautical Telecommunications Annex 10. Aircraft equipment should be checked to assure the receiving capability of all channels.

Sequence or Channel Number	Localizer Mc/s	Glide Path Mc/s	Sequence or Channel Number	Localizer Mc/s	Glide Path Mc/s
1	110.3	335.0	11	108.1	334.7
2	109.9	333.8	12	108.3	334.1
3	109.5	332.6	13	108.5	329.9
4	110.1	334.4	14	108.7	330.5
5	109.7	333.2	15	108.9	329.3
6	109.3	332.0	16	111.1	331.7
7	109.1	331.4	17	111.3	332.3
8	110.9	330.8	18	111.5	332.9
9	110.7	330.2	19	111.7	333.5
10	110.5	329.6	20	111.9	331.1

MAINTENANCE OF FAA NAVAIDS

1. During periods of routine or emergency maintenance, the coded identification (or code and voice, where applicable) will be removed from certain FAA Navaids, namely, ILS localizers, VHF ranges and L/MF ranges but not from "H" facilities, compass locators or 75 mc marker beacons. The removal of identification serves as warning to pilots that the facility has been officially taken over by "Maintenance" for tune-up or repair and may be unreliable even though on the air intermittently or constantly.

NAVAIDS WITH VOICE

1. Voice equipped en route radio navigational aids are under the operational control of an FAA Flight Service Station (FSS), or an approach control facility. Most are remotely operated.

2. Unless otherwise noted on the chart, all radio navigation aids operate continuously except during interruptions for voice transmissions on the same frequencies where simultaneous transmission is not available, and during shutdowns for maintenance purposes. Hours of operation of those facilities not operating continuously are annotated on the charts.

SIMULTANEOUS VOICE TRANSMISSIONS FROM A SINGLE LOCATION

1. At several FAA facilities, simultaneous voice transmissions are made from a single location. For example, the New York FSS controls the transmitters at Hampton and Riverhead VOR's.

2. To provide a uniformly brief announcement, generally for broadcast purposes, the name of the controlling facility, followed by the word AREA will be used, e.g., THIS IS NEW YORK AREA RADIO, etc.

3. Call from aircraft will be answered using the name of the station as stated by the pilot, e.g., a pilot calling "Riverhead Radio" will be answered by the New York FSS, "THIS IS RIVERHEAD RADIO, etc

4. The word "AREA" signifies that the transmission from the named (controlling) location is emanating simultaneously from two or more remotely controlled facilities, having a different name or names.

FREQUENCY UTILIZATION PLAN

AIR NAVIGATION AIDS

108.1–111.9 mc: ILS localizer with simultaneous radiotelephone channel operating on odd-tenth decimal frequencies (108.1, 108.3 etc.)

108.2–111.8 mc: VOR's operating on even-tenth decimal frequencies (108.2, 108.4 etc.).

112.0–117.9 mc: Airway track guidance. (VORs)

COMMUNICATIONS

118.0–121.4 mc: AIR TRAFFIC CONTROL COMMUNICATIONS

121.5 mc: EMERGENCY (WORLD-WIDE)

121.6–121.95 mc: AIRPORT UTILITY

122.1, 122.2 mc: PRIVATE AIRCRAFT ENROUTE

122.5, 122.7, 122.6, 122.4 mc: PRIVATE AIRCRAFT TO TOWERS

122.8, 123.0 mc: AERONAUTICAL ADVISORY STATIONS (UNICOM)

122.9 mc: AERONAUTICAL MULTICOM STATIONS

123.1–123.55 mc: FLIGHT TEST AND FLYING SCHOOLS

123.6–128.8 mc: AIR TRAFFIC CONTROL COMMUNICATIONS

126.7 mc: FLIGHT SERVICE STATIONS

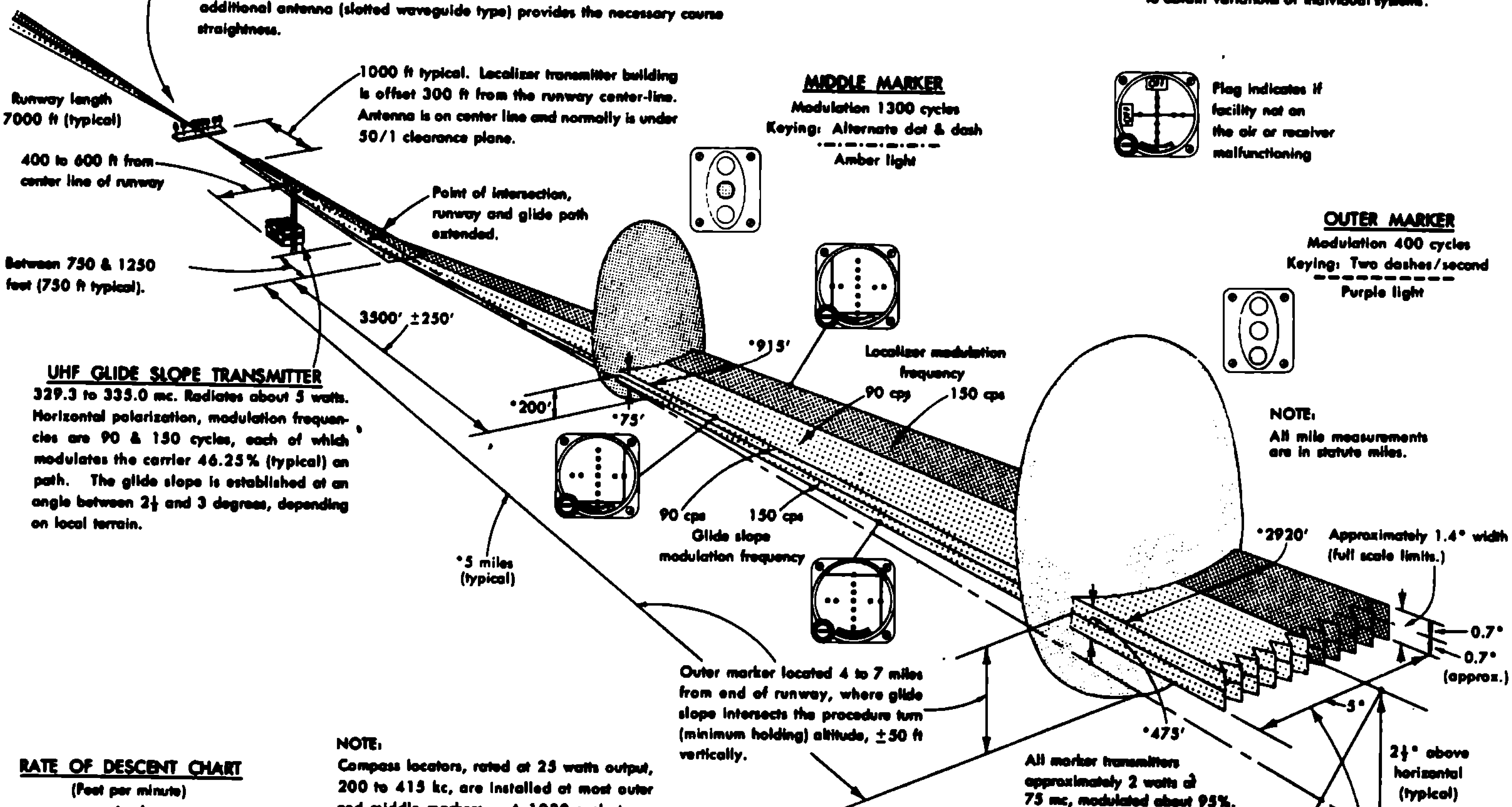
128.85–132.0 mc: AERONAUTICAL ENROUTE STATIONS (AIR CARRIER)

132.05–135.95 mc: AIR TRAFFIC CONTROL COMMUNICATIONS

135.9 mc: FLIGHT SERVICE STATIONS

ILS
(FAA Instrument Landing System)
STANDARD CHARACTERISTICS AND TERMINOLOGY

ILS approach charts should be consulted to obtain variations of individual systems.



RATE OF DESCENT CHART
(Feet per minute)

Speed (knots)	Angle 2½°	2¾°	3°
90	400	440	475
110	485	535	585
130	575	630	690
150	665	730	795
160	707	778	849

NOTE:
Compass locators, rated at 25 watts output, 200 to 415 kc, are installed at most outer and middle markers. A 1020 cycle tone, modulating the carrier about 95%, is keyed with the first two letters of the ILS identification on the outer locator and the last two letters on the middle locator. At some locators, simultaneous voice transmissions from the control tower are provided, with appropriate reduction in identification percentage.

*Figures marked with asterisk are typical. Actual figures vary with deviations in distances to markers, glide angles and localizer widths.

Prepared at Washington, D.C., by the U.S. Coast and Geodetic Survey

RADIO INTERFERENCE

1. You can do your part toward reducing radio interference to aeronautical services from nonaeronautical sources which may be noted during flight if such is reported promptly to an FAA facility (preferably after landing) or to an FCC field office. Reports should state the frequency or channel affected, description of the interference, and the geographical area where the interference was observed. If known, reports should give the apparent cause of the interference such as radio stations, call letters when such can be identified, industrial plants, diathermy machines, power lines, television receivers, etc. Do not report interference caused by normal frequency congestion, i.e., signals from other aircraft using the frequency.

2. In complex aircraft radio installations involving more than one receiver, there are many combinations of possible interference between units. This interference can cause either erronous navigation indications or complete or partial blanking out of the communications. Pilots should be familiar enough with the radio installation of particular airplanes they fly to recognize this type of interference. Explanations of this type of interference are contained in Bureau of Flight Standards Release 436 and Fight Standards Service Release 450. Copies can be obtained by writing to the Federal Aviation Agency, Correspondence Inquiry Section, HQ-440, Publishing and Graphics Division, Washington, D.C., 20553.

CONSOLAN

1. Consolan is a long-range navigation aid operating in the low/medium frequency band.

2. A receiver equipped with CW (BFO) position without AVC should be used. When a loop antenna is used, best results are obtained by placing the loop on the maximum signal position.

3. Three stations are now operating within the United States—Nantucket (TUK) 194 kc, San Francisco (SFI) 192 kc, and Miami (MMF) 190 kc.

4. A range of 1000–1400 nautical miles or more is to be expected. Greatest range is found over sea-water. The range depends on the receiver, noise, ground conductivity, ionospheric conditions, frequency, and transmitter power. With experience, operators can obtain accurate bearings through considerable noise. Narrow band receivers provide a high operational range. The systems are not usable within 25 miles of the station.

5. Operating details and the necesary tables are included in the International Flight Information Manual.

VHF/UHF DIRECTION FINDER

1. The VHF/UHF Direction Finder (VHF/UHF/DF) is one of the Common System equipments that helps the pilot without his being aware of its operation. The VHF/UHF/DF is a ground-based radio receiver used by the operator of the ground station where it is located.

2. The equipment consists of a directional antenna system, a VHF and a UHF radio receiver. At a radar-equipped tower or center, the cathode-ray tube indications may be superimposed on the radarscope.

3. The VHF/UHF/DF display indicates the magnetic direction of the station from the aircraft each time the aircrat transmits. Where DF equipment is tied into radar, a strobe of light is flashed from the center of the radarscope in the direction of the transmitting aircraft.

4. DF equipment is of particular value in locating lost aircraft and in helping to identify aircraft on radar.

RADAR

GENERAL

1. FAA radar units operate continuously at the locations shown in the Airport/Facility Directory and their services are available to all pilots, both civil and military. Contact the associated FAA control tower or ARTCC on any frequency guarded for initial instructions, or in an emergency, any FAA facility for information on the nearest radar service.

2. Radar Traffic Information Service Procedures, Expanded Radar Service for Arriving and Departing Flights in Terminal Areas Procedures, and Terminal Radar Service Procedures are published under "ARRIVAL."

SURVEILLANCE RADAR

1. Surveillance radars are divided into two general categories: Airport Surveillance Radar and Air Route Surveillance Radar. Airport Surveillance Radar (ASR) is designed to provide relatively short range coverage in the general vicinity of an airport and to serve as an expeditious means of handling terminal area traffic through observation of precise aircraft locations on a radarscope. The ASR can also be used as an instrument approach aid. Air Route Surveillance Radar (ARSR) is a long-range radar system designed primarily to provide a display of aircraft locations over large areas. It will not normally be used as the basis for instrument approaches, nor to provide traffic separation in terminal areas at low altitudes.

2. Surveillance radars scan through 360° of azimuth and present target information on a radar display located in a tower or center. This information is used independently or in conjunction with other navigational aids in the control of air traffic.

RADAR CONTROLLED APPROACHES (FAA RADAR FACILITIES ONLY)

1. The only airborne radio equipment required for radar controlled approaches is a functioning radio transmitter and receiver. By means of radar, the controller closely follows the flight path of aircraft and issues instructions to align these with the center line of the runway, and keep them on course until the pilot can complete his approach and landing by visual reference to the surface.

2. Radar approaches will be given upon request and may be suggested to pilots of aircraft in distress or to expedite traffic. Acceptance of a protection or surveillance approach by a pilot does not waive the prescribed weather minimums for the airport or for the particular aircraft operator concerned. The decision to make a radar controlled approach when the reported weather is below the established minimums rests with the pilot.

3. Precision and surveillance approach minimums are published on separate pages in the C & GS Approach and Landing Chart Manuals.

a. **A PRECISION APPROACH** is one in which the controller provides highly accurate navigational guidance in azimuth and elevation to a pilot. Pilots are given headings to fly, to direct them to, and keep their aircraft aligned with, the extended center line of the landing runway. They are told to anticipate glide slope interception approximately 15 to 30 seconds before it occurs, when to start descent, and they may be given a rate of descent based on the glide slope angle and the approach speed of the aircraft. If the aircraft is observed to deviate above or below the glide slope, the pilot is given the amount of deviation and asked to adjust his rate of descent to return to the glide slope. Range from touchdown is given at least once each mile. If an aircraft is observed to proceed outside of specified safety zone limits in azimuth and/or elevation and continue to operate outside these prescribed limits, the pilot will be directed to climb to a specified altitude and to fly a specified course if he is not navigating by visual reference to the surface. Navigational guidance in azimuth and elevaton is provided to the pilot until the aircraft passes over the approach end of the runway, at which point he is advised of any deviation from the runway center line and directed to take over visually and complete his landing.

b. **A SURVEILLANCE APPROACH** is one in which the controller provides navigational guidance in azimuth only. The pilot is furnished headings to fly to align his aircraft with the extended center line of the landing runway, but since the radar information used for a surveillance approach is considerably less precise than that used for a precision approach, the accuracy of the approach will not be as great and higher weather minimums will apply. Guidance in elevation is not possible, but the pilot will be given a point at which to start a rate of descent based on a desirable glide angle and the speed of the aircraft concerned. In addition, the pilot will be advised of his distance from the end of the runway each mile on final and concurrently recommended altitudes (mean sea level) above/to the published ceiling minimum will be furnished at each mile. No recommended altitudes will be furnished at other than whole mile distances or when such altitudes are below the ceiling minimum published for the approach being made. A pilot may be guided to any runway having an approved surveillance approach. Navigational guidance is provided until the aircraft reaches a point one mile from the approach end of the runway. At this point, he is given his distance from the runway and directed to execute a missed approach if he does not have runway in sight at landing minimums.

c. **A NO–GYRO APPROACH** is available to a pilot under radar control who experiences circumstances wherein his directional gyro or other stabilized compass is inoperative or inaccurate. When this occurs, he should so advise air traffic control and request a No-Gyro vector or approach. Pilots of aircraft not equipped with a directional gyro or other stabilized compass who desire radar

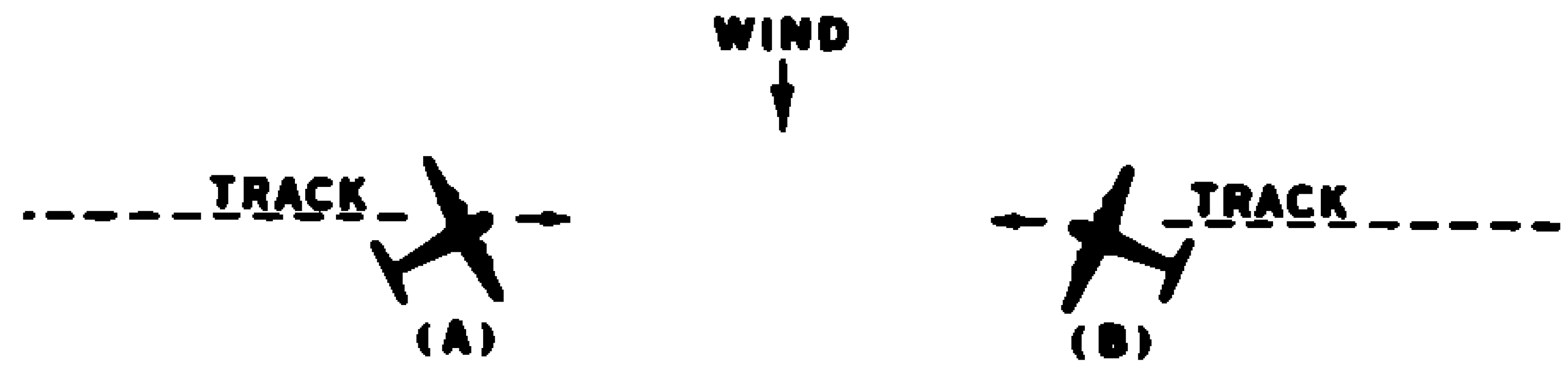
handling may also request a No-Gyro vector of approach. Prior to commencing such vector/approach the pilot will be advised to make all turns at standard rate, and that turn instructions should be executed immediately upon receipt. For example, "TURN RIGHT," "STOP TURN." When a surveillance or precision approach is made, the pilot will be advised after his aircraft has been turned onto final approach to make turns at half standard rate.

AIR TRAFFIC CONTROL RADAR BEACON SYSTEM (ATCRBS)

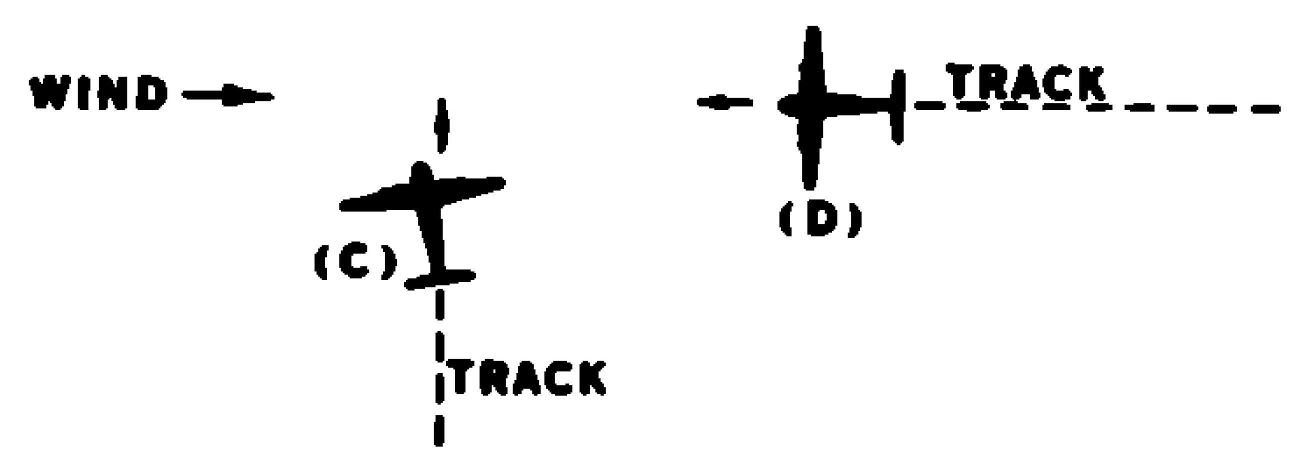
1. Airborne transponders and ground interrogators, making up the air traffic control radar beacon system, give controllers a positive radar return, overcoming the difficulty experienced with some aircraft that have poor reflecting characteristics. The primary functions of the radar beacon system are to provide reinforcement of radar replies, permitting the aircraft to be tracked reliably through heavy ground clutter and precipitation and a positive means of identifying aircraft to the air traffic controller. Radar beacons are frequently referred to as "secondary radars." Radar beacon procedures are published in Section II.

RADAR TRAFFIC INFORMATION

1. Radar traffic information is issued by air traffic controller as a clock position with relation to the track (course) of an aircraft. The examples depicted below point out the possible error in the position of this traffic when it is necessary for a pilot to apply drift correction to maintain this track. This error could also occur in the event a change in course is made at the time radar traffic information is issued.



In above example traffic information would be issued to the pilot of aircraft "A" as 12 o'clock. The actual position of the traffic as seen by the pilot of aircraft "A" would be one o'clock. Traffic information issued to aircraft "B" would also be given as 12 o'clock, but in this case, the pilot of "B" would see his traffic at 11 o'clock.



In above example traffic information would be issued to the pilot of aircraft "C" as two o'clock. The actual position of the traffic as seen by the pilot of aircraft "C" would be three o'clock. Traffic information issued to aircraft "D" would be at an 11 o'clock position. Since it is not necesary for the pilot of aircraft "D" to apply wind correction (crab) to make good his track, the actual position of the traffic issued would be correct. Since the radar controller can only observe aircraft track (course) on his radar display, he must issue traffic advisories accordingly, and pilots should give due consideration to this fact when looking for reported traffic.

AIRPORT, AIR NAVIGATION LIGHTING AND MARKING AIDS

AERONAUTICAL (LIGHT) BEACONS

1. The aeronautical beacon is a visual navaid displaying flashes of white and/or colored light, which is used to indicate the location of airports, landmarks, and certain points of the Federal airways in mountainous terrain and to mark hazards. The principal light so used is a rotating beacon of relatively high intensity, which is often supplemented by nonrotating flashing lights of lesser intensity. (Reference FAA Technical Standard Order TSO–N7a.)

2. The color or color combination displayed by a particular beacon and/or its supplementary lights tells whether the beacon is indicating a landing place, landmark, point of the Federal airways, or hazard. Coded flashes of the supplementary lights, if employed, further identify the beacon site.

ROTATING BEACON

1. The rotating beacon has a vertical light distribution such as to make it most effective at angles of one to three degrees above the horizontal from its site; however, it can be seen well above and below this peak spread. Rotation is in clockwise direction when viewed from above. It is always rotated at a constant speed which produces the visual effect of flashes at regular intervals. Flashes may be one or two colors alternately. The total number of flashes are:

12 to 15 per minute for beacons marking airports, landmarks, and points on Federal airways.

12 to 40 per minute for hazard beacons.

AUXILIARY LIGHTS

1. The auxiliary lights are of two general kinds: code beacons and course lights. The code beacon, which can be seen from all directions, is used to identify airports and landmarks and to mark hazards. The number of code beacon flashes are:

a. **Green coded flashes** not exceeding 40 flashes or character elements per minute, or constant flashes 12 to 15 per minute, for identifying land airports.

b. **Yellow coded flashes** not exceeding 40 flashes or character elements per minute, or constant flashes 12 to 15 per minute, for identifying water airports.

c. **Red flashes,** constant rate, 12 to 40 flashes per minute, for marking hazards.

2. The course light, which can be seen clearly from only one direction, is used only with rotating beacons of the Federal Airway System; two course lights, back to back, direct coded flashing beams of light in either direction along the course of airway (see "Airway Beacons" below).

COLOR

1. The colors and color combinations of rotating beacons and supplementary lights are basically:

White and Green	Lighted land airport
*Green alone	Lighted land airport
White and Yellow	Lighted water airport
*Yellow alone	Lighted water airport
White and Red	Landmark or navigational point
White alone	Unlighted land airport (rare installation)
Red alone	Hazard

*Green alone or yellow alone is used only in connection with a not far distant white-and-green or white-and-yellow beacon display, respectively.

LIGHTED LAND AIRPORTS (WHITE AND GREEN)

1. Alternating white and green flashes indicate the presence of a lighted land airport or intermediate field at, or not very far from, the beacon site.

a. **Alternating white and green flashes** from a rotating beacon indicate that the beacon is at, or within 2 miles of, a lighted airport or intermediate landing field. (This is the installation usually seen).

b. **A white and green combination** from a rotating beacon flashing white only, accompanied by coded green flashes from directional course lights, means that the beacon is on a Federal airway and that an intermediate field or airport (usually small) is within 2 miles. (This installation is relatively rare.)

c. **Green flashes alone,** usually coded, from a code beacon used by itself, means that the code beacon is located at or beside a lighted airport. (When the rotating beacon facility showing alternate white and green is located more than 5000 feet from the airport or landing field, the green-flashing code beacon is used to show more exactly the location of the landing area.)

LIGHTED WATER AIRPORTS (WHITE AND YELLOW)

1. White and yellow flashes indicate the presence of a lighted water airport at, or not very far from, the beacon site.

a. **Alternating white and yellow flashes** from a rotating beacon indicate that the beacon is at, or within 2 miles of, a lighted water airport.

b. **Yellow flashes alone,** usually coded, from a code beacon used by itself, means that the code beacon is located at, or beside a lighted water airport—when there is a white and yellow flashing beacon within 2 miles. (When the rotating beacon showing alternate white and yellow is located more than 5000 feet from the water airport, the yellow flashing code beacon is used to show more exactly the location of the landing area.)

LANDMARKS (WHITE AND RED)

1. White and red flashes indicate the location of a natural or man-made landmark or a point on the Federal airways.

a. Alternating white and red flashes from a rotating beacon may be either a landmark or a site on the Federal airways.

b. A white and red combination from a rotating beacon flashing white only, accompanied by a coded red flashes from directional course lights, means that the beacon marks a point on the Federal airways near which there is no landing area.

HAZARDS (RED ALONE)

1. Red flashes only from a rotating beacon or a code beacon mean the presence of an obstruction or obstructions to air navigation or an area on the ground used for purposes hazardous to air navigation. (Reference "*Obstruction Marking and Lighting Manual*" issued by the Federal Aviation Agency).

2. Steady burning red lights are employed near airports to mark obstructions and are also used to supplement flashing lights in marking en route obstructions.

MILITARY AIRPORTS

1. Military airport beacons flash alternately white and green, but are differentiated from civil beacons by dual-peaked (two quick) white flashes between the green flashes.

DAYLIGHT BEACON OPERATION

1. Operation of an airport rotating beacon during the hours of daylight, means that the ground visibility in the control zone is less than three miles and/or the ceiling is less than 1000 feet and that a traffic clearance is required for landings, take-offs, and flight in the traffic pattern.

AIRPORT IDENTIFYING CODE

1. Where airport identification is required, the code beacon for land or water airports may be assigned an exclusive code characteristic, which is printed on Sectional Aeronautical Charts.

AIRWAY BEACONS

1. Airway beacons are remnants of the "lighted" airways which antedated the present electronically equipped Federal Airway System. The lighted airways are delineated by rotating beacons spaced from 10 to 15 miles apart along the airway between airports, with an intermediate landing field at about every third beacon. Usually mounted on a tower with the rotating beacon were two directional flashing auxiliary lights, trained in either direction along the course of an airway, hence called course lghts.

2. Each beacon site is numbered, and course lights when employed, flash an identifying code. Both the beacon site number and the corresponding code flash are printed on the Sectional Aeronautical Charts. The numbering bears a direct relation to the distance from the beacon to the city where the airway originates.

3. Federal airways are considered to extend from south to north and from west to east. For beacon numbering purposes, each airway is divided into ten-mile "blocks". A beacon is numbered according to block, or distance it is located along the airway. For example, the course lights of the Number 3 beacon on the Salt Lake City-Great Falls airway, flashes a special code indicating "Site 3". This flashing code tells the pilot that he is about 30 miles north of Salt Lake City.

4. Occasionally two beacon sites fall within the same ten-mile block, in which case, they flash the same code number. This special code, numbering from 1 to 10, repeats itself along the airway. Accordingly, Sites 3, 13, 23, etc., will each flash the special code "3"; but this repetition should not be confusing because there will be 100 miles between the same code flash. Pilots should note that the block system of numbering and the decommissioning of certain beacons, often result in successive beacons not being in consecutive numerical order.

5. The special course light code, with a means of remembering it, is:

Directional Course Light Code

Beacon Number	1	2	3	4	5
Code Flashes	● ▬	● ● ▬	● ● ● ▬	● ● ● ●	● ▬ ●
International Code	When	Undertaking	Very	Hard	Routes
	6	7	8	9	10
	▬ ● ▬	▬ ● ●	▬ ● ● ●	▬ ●	▬
	Keep	Directions	By	Good	Methods

ROTATING BEACON VS CODE BEACON OR COURSE LIGHT

1. The flash of rotating beacons is produced by the revolving motion without change in light intensity and is therefore a sharp well-defined flash. The flash of code beacons and course lights is produced by making and breaking the electric circuit and the resulting heating and cooling of the lamp filament causes the light to rise perceptibly to a peak intensity and then fade. This provides one means for the pilot to tell them apart.

DEVIATIONS FROM STANDARDS

1. The foregoing outlines the intended installation and interpretation of aeronautical light beacons in accordance with agreed standards to which the beacons are required to conform in basic characteristics. However, pilots are alerted to the existence of occassional minor deviations from the exact installations described, and advised to make allowances for inconsistencies.

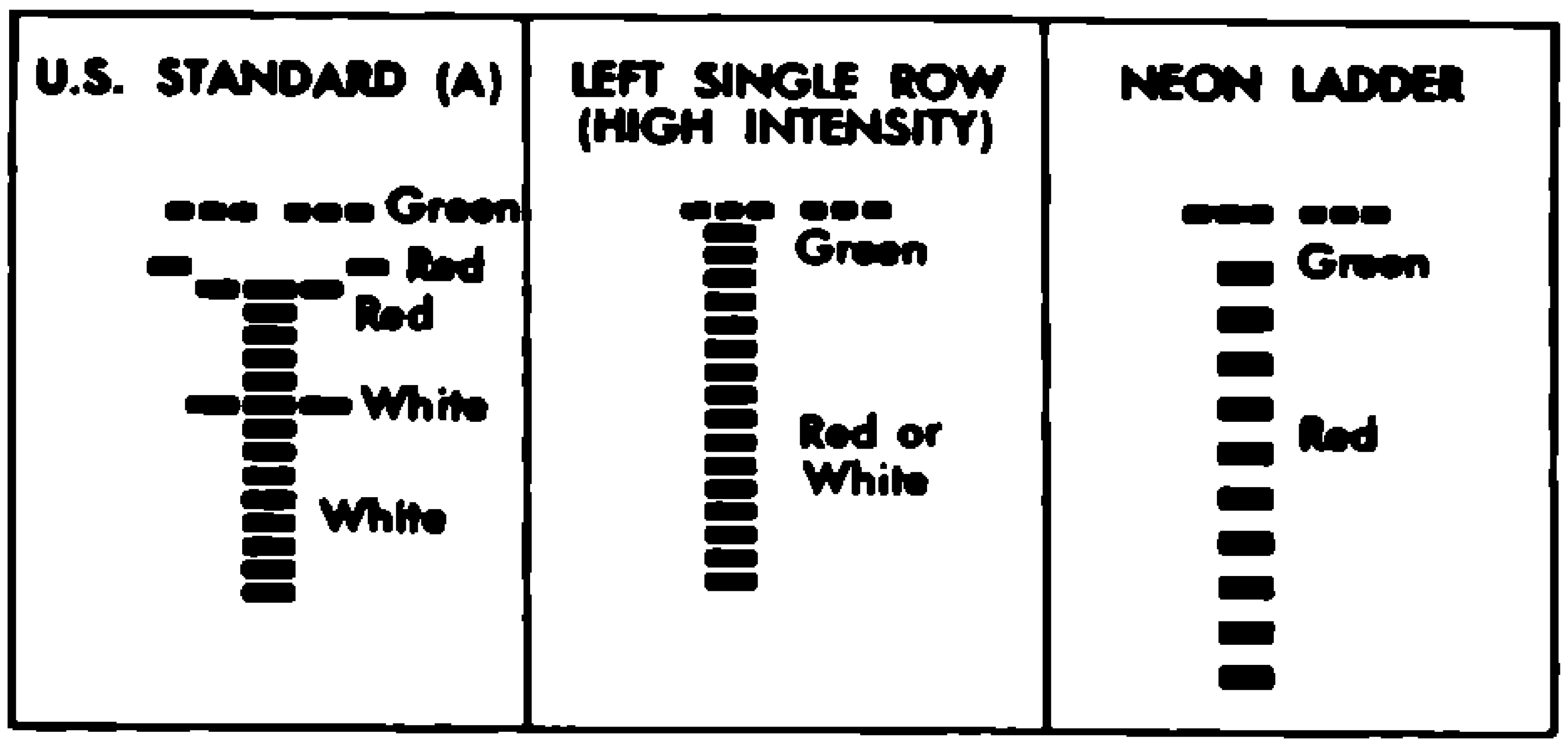
INSTRUMENT APPROACH LIGHT SYSTEMS

1. Instrument approach light systems provide the basic means for transition from instrument flight using electronic approach aids to visual flight and landing. Inadequate knowledge results in an increased probability of missed approaches during minimum weather conditions, imposing a greater burden on air traffic control facilities and delaying other aircraft.

2. Configuration "A" Centerline Approach Lighting System has been adopted as the U.S. National Standard. One hundred and ninety-four of these systems have been hundred and ninety-four of these systems have been commissioned to date with a total of 220 currently programmed. Although configuration "A" has been adopted as the U.S. Standard, the Neon Ladder and the Left Single Row configurations can still be found at a few civil airports. Approach and Landing Charts depict the approach light configuration at each airport.

INSTRUMENT APPROACH LIGHT SYSTEMS *(Con't)*

3. Condenser-Discharge Sequenced Flashing Light Systems are installed at airports which have U.S. Standard "A" approach lights as a further aid to pilots making instrument approaches. The system consists of a series of brilliant blue-white bursts of light flashing in sequence along the approach lights. It gives the effect of a ball of light traveling towards the runway. An impression of the system as a pilot first observes the flashing lights when making an approach is that of large tracer shells rapidly fired from a point in space toward the runway. These light sources provide vital information to pilots approaching a runway under instrument conditions. They penetrate severe atmospheric conditions, attracting the pilot's eyes to the location of the approach lighting system.



VISUAL APPROACH SLOPE INDICATOR (VASI)

1. VASI is designed to provide by visual reference the same information that the glide slope unit of an ILS provides electronically. It provides a visual light path within the approach zone, at a fixed plane inclined 2½° to 4° from horizontal which an approaching pilot can see and utilize for descent guidance during an approach to a landing. The element of course guidance is obtained from reference to the runway lights.

2. Standard installation of the complete system consists of 12 light source units arranged in light bars with three units placed on each side of the runway, opposite the 600-foot mark (threshold)and three on each side of the runway at the 1,300-foot mark. These are the downwind and upwind bars respectively. The Visual Glide Slope reference point is midway between the upwind and downwind bars.

3. Provision is made for controlling the intensity of the lights and adjustments can be made at pilot request. The VASI can normally be seen at the approximate range of the outer marker (4–5 miles) and at greater distances at night. Under sunlight or snow conditions the range is decreased to about 3.5 nautical miles.

4. The following is offered to pilots as yet unfamiliar with the principles and operation of this system and the pilot technique required. The basic principle of the VASI is that of color differentiation between red and white. Each light unit project a beam of light having a white color in the upper part and a red color in the lower part. The light units are arranged so that the pilot of an aircraft during approach will see the following:

(a) Above glide slope:	white white	white white
(b) On glide slope:	red white	red white
(c) Below glide slope:	red red	red red

5. When on the proper glide, the pilot is in effect overshooting the bars nearer the threshold and undershooting the bars farther down. Thus he will see the downwind bars as white and the upwind bars as red. A position below the glide path will cause both bars to be red, and a high position will cause both bars to be white. Impending departure from the glide path is indicated to the pilot by a transition in color from red through pink to white or vice versa. A movement to the high side will cause the upwind bars to change from red through pink to white. A descent below the glide path will change the downwind bars from white through pink to red. When the pilot is below the glide path the pair of red bars visible on each side of the runway will tend to merge into one bold red signal on each side of the runway if descent continues to be excessive and takes the pilot well below the glide path.

6. In haze and dust conditions or when an approach is made into the sun, the white bars of the system may appear yellowish. This is also true at night when the VASI system is operated at a low intensity. Certain atmospheric debris may give the white lights an orange or brownish tint; however, the red lights are not affected and the principle of color differentiation is still applicable.

IN-RUNWAY LIGHTING

1. Touchdown zone lighting and runway centerline lighting are installed on some precision approach runways to facilitate landing under adverse visibility conditions. Taxiway turnoff lights may be added to expedite movement of aircraft from the runway.

a. **Touchdown Zone Lighting**—two rows of transverse light bars disposed symmetrically about the runway centerline in the runway touchdown zone. The system generally extends from 75 to 125 feet of the landing threshold to 3000 feet down the runway.

b. **Runway Centerline Lighting**—flush centerline lights spaced at 25-foot intervals beginning 75 feet from the landing threshold and extending to within 75 feet of the opposite end of the runway.

c. **Taxiway turnoff lights**—flush lights spaced at 12½-foot intervals, defining the curved path of aircraft travel from the runway centerline to a point on the taxiway.

RUNWAY END IDENTIFIER LIGHTS (REIL)

1. Runway End Identifier Lights are installed at many airfields to provide rapid and positive identification of the approach end of a particular runway. The system consists of a pair of synchronized flashing lights, one of which is located laterally on each side of the runway threshold facing the approach area. They are effective for:

a. Identification of a runway surrounded by a preponderance of other lighting.

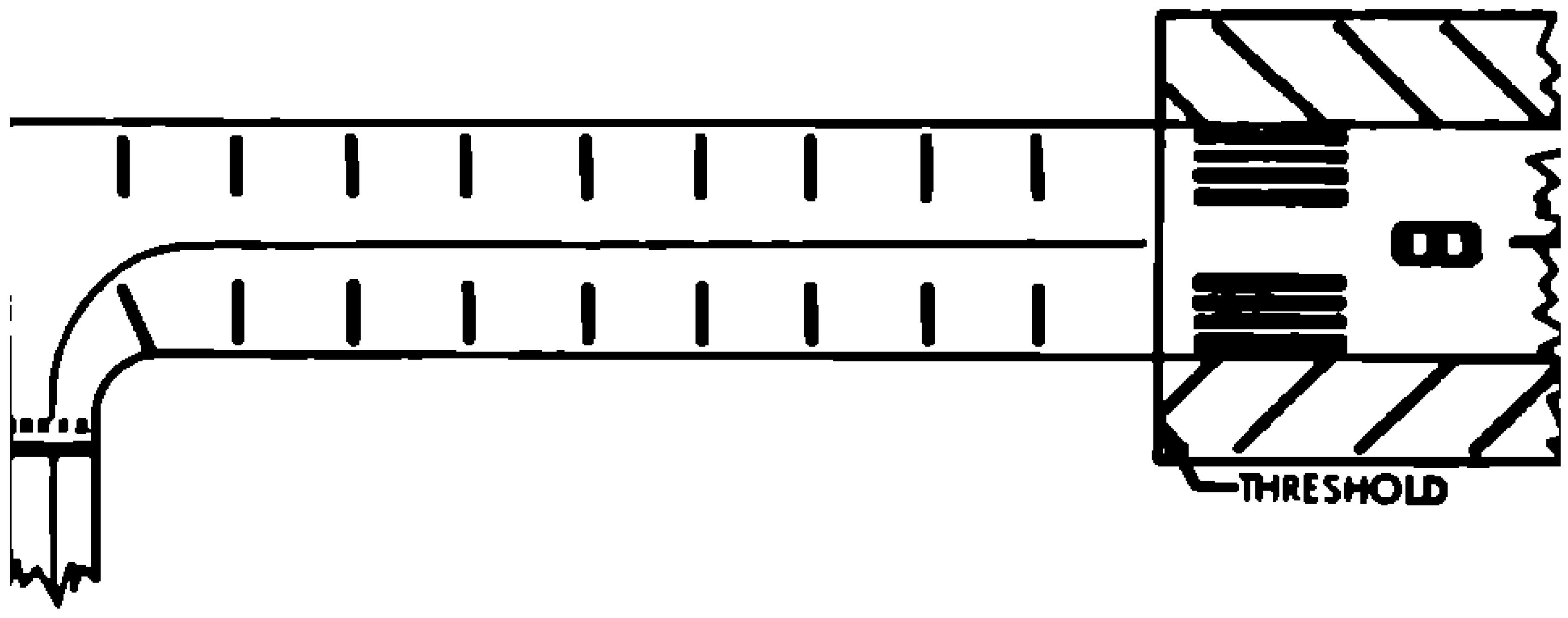
b. Identification of a runway which lacks contrast with surrounding terrain.

c. Identification of a runway during reduced visi bility.

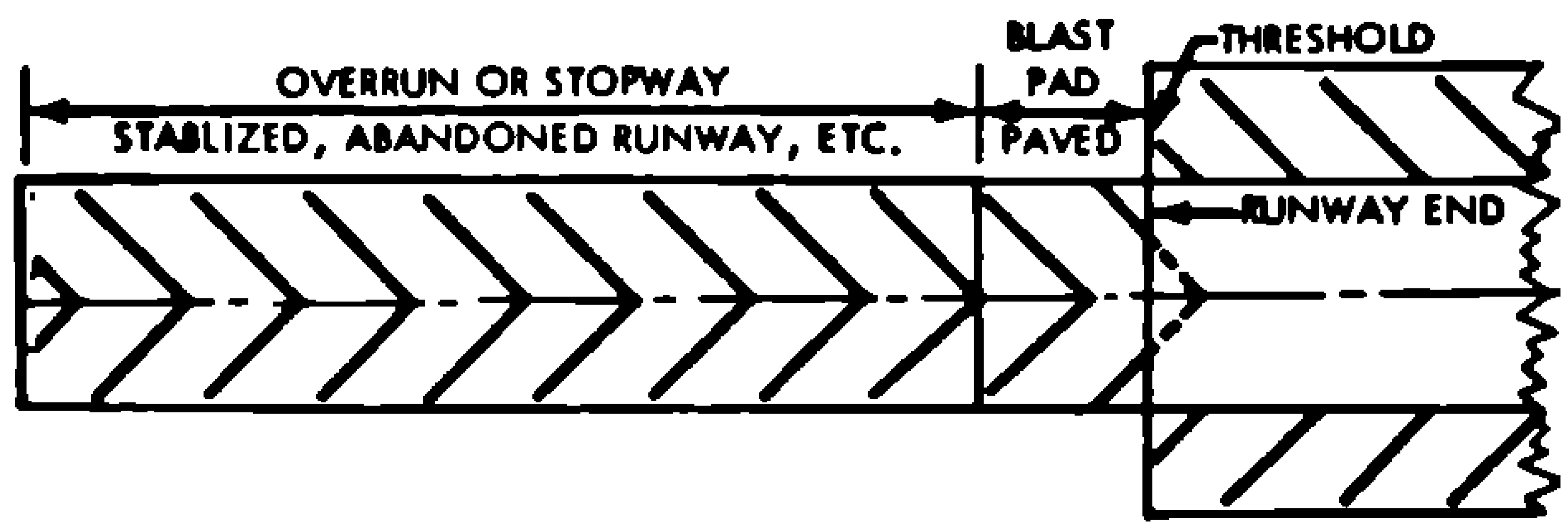
MARKING

1. In the interest of safety, regularity, or efficiency of aircraft operations, the FAA has recomended for the guidance of the public the following airport marking. (Runway numbers and letters are determined from the approach direction. The number is the whole number nearest one-tenth the magnetic azimuth of the centerline

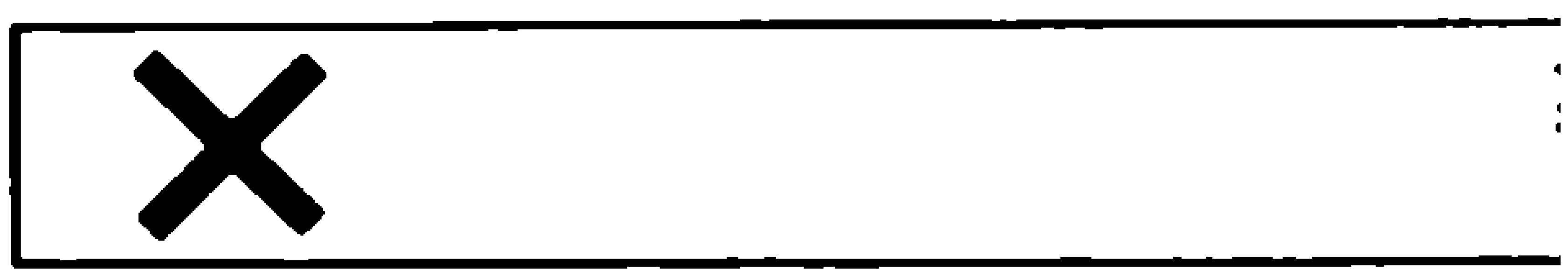
f. Deceptive Area—Any surface or area which appea
able but which, due to the nature of its structure,
t intended for normal operational use by aircraft.



1. RELOCATED THRESHOLD



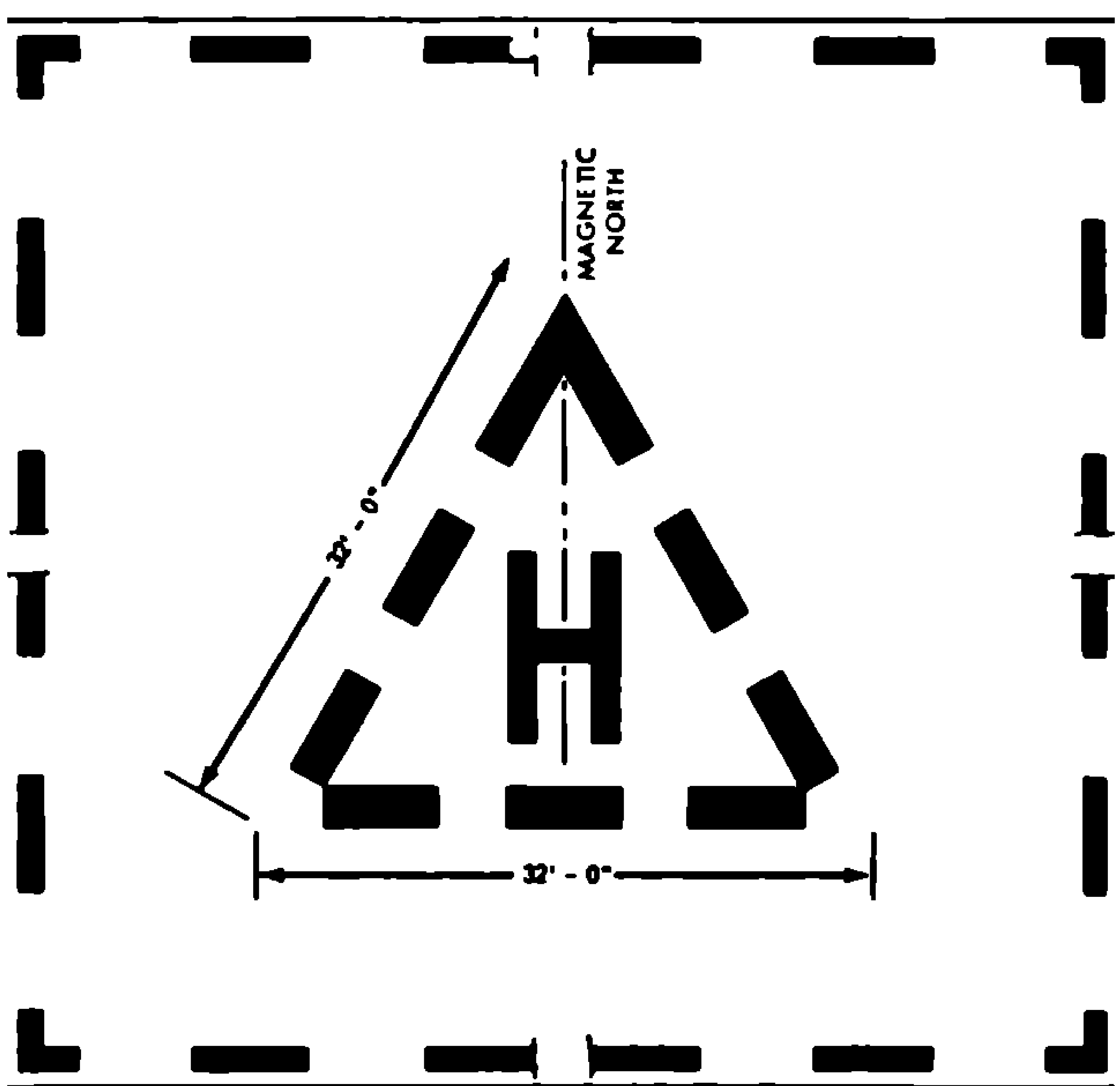
2. OVERRUN/STOPWAY AND BLAST PAD AREA



3. CLOSED RUNWAY OR TAXIWAY

g. Detailed Airport Marking Information is published in FA **lvisory Circulars 150/5340–1 'Marking of Serviceable Runwa** **d Taxiways" and 150/5340–7 "Marking of Deceptive, Close** **d Hazardous Areas on Airports.**

HELICOPTER LANDING AREA



RADIOTELEPHONE PHRASEOLOGY AND TECHNIQUES

AIRCRAFT CALL SIGNS

1. During the initial contact with a ground station, the complete aircraft call sign is used. Civil itinerant aircraft pilots should use the make or type name of their aircraft, followed by the complete certification number.

Example:
"CESSNA ONE TWO THREE FOUR TANGO."

2. Air carrier aircraft pilots may utilize their company name or abbreviated name, followed by their trip number in group form.

Example:
"UNITED TWENTY-FIVE."

3. Military aircraft pilots may use whichever of the following is applicable:

a. The service name or designated prefix followed by the last 5 digits of the serial number.

Example:
"AIR FORCE ('JET' when appropriate) FOUR FOUR NINER THREE TWO" or "MATS FOUR FOUR NINER THREE TWO."

b. The service name or designation followed by the word "RESCUE" and the 5 digits of the serial number.

c. Assigned voice call signs consisting of a selected authorized code word followed by a two-digit flight number.

Example:
"ANDY TWO ZERO."

d. Assigned double-letter ,two-digit flight numbers.

Example:
"ALPHA KILO ONE FIVE."

4. After radio contact has been established, and when conditions warrant, the call signs of itinerants may be reduced to the prefix followed not less than the last three digits or letters of the full call sign.

Example:
"CESSNA SIX TWO YANKEE."

GROUND STATION CALL SIGNS

1. Ground station call signs shall comprise the name of the location or airport, followed by the appropriate indication of the type of station:

OAKLAND TOWER (airport traffic control tower);
MIAMI GROUND CONTROL (ground control position in tower);
DALLAS CLEARANCE DELIVERY (IFR clearance delivery position);
KENNEDY APPROACH CONTROL (tower radar or nonradar approach control position);
ST. LOUIS DEPARTURE CONTROL (tower radar departure control position);
WASHINGTON RADIO (FAA Flight Service Station);
NEW YORK CENTER (FAA Air Route Traffic Control center).

CONTACT PROCEDURE

1. Each contact generally comprises four parts as follows:

a. **The Call-up,** consisting of the call sign of the station being called, the words "THIS IS", the call sign of the caller, and the word "OVER."

b. **The Reply,** consisting of the call sign of the station being called, the words "THIS IS", the call sign of the caller, and the word "OVER."

c. **The Message,** is that portion of the contact which conveys information or requests same.

d. **The Acknowledgement and Ending,** consisting of the aircraft call sign (regardless of whether the acknowledgement is being made by an aircraft or ground station) the word "ROGER" and, if the contact is to be closed, the word "OUT."

2. Radiotelephone contacts may be abbreviated by omitting the words "THIS IS", "OVER" and "OUT" during periods of high radio activity and when no confusion or misunderstanding is liable to occur. When a message is short or when it is probable that the call-up will be heard without difficulty, the message may be transmitted following the call-up without waiting for a reply or invitation to go ahead.

3. In the following example the words which may be omitted under abbreviated procedures are enclosed within parentheses:

Aircraft—CLEVELAND TOWER (THIS IS) BEECHCRAFT ONE EIGHT FOUR ONE, OVER.
Tower—BEECHCRAFT ONE EIGHT FOUR ONE (THIS IS) CLEVELAND TOWER, (OVER).
Aircraft—(CLEVELAND TOWER) (THIS IS) BEECHCRAFT (ONE) EIGHT FOUR ONE, FOUR MILES SOUTH (AT) ONE THOUSAND, LANDING AT CLEVELAND, OVER.
Tower—BEECHCRAFT EIGHT FOUR ONE, FOUR MILES SOUTH (AT) ONE THOUSAND (CLEARED TO ENTER TRAFFIC PATTERN) RUNWAY ONE EIGHT, WIND SOUTH ONE TWO, OVER.
Aircraft—BEECHCRAFT EIGHT FOUR ONE (ROGER) (OUT).
Tower—(CLEVELAND TOWER, OUT).

4. After contact has been definitely established, it may be continued without further call-up or identification.

MICROPHONE TECHNIQUE

1. Proper microphone technique is important in radiotelephone communications. Transmissions should be concise and in a normal conversational tone.

NOTE.—Identification of Aircraft—Pilots are requested to exercise care that the identification of their aircraft is clearly transmitted in each contact with an ATC facility. Also pilots should be certain that their aircraft are clearly identified in ATC transmissions before taking action on an ATC clearance. Garbled aircraft identifications in radiotelephone transmissions should never be taken for granted but should always be checked.

MICROPHONE TECHNIQUE (Con't)

2. When originating a radiotelephone call-up to any air-ground facility, indicate the channel on which reply is expected, if other than normal.

3. Keep your contacts as brief as possible. Pilots should not read back altimeter setting, taxi instructions, wind and runway information to towers except for verification or clarification of instructions. Other pilots are waiting to use the channel.

4. Contact the nearest Flight Service Station. Don't continually attempt to see how far your transmitter will reach.

5. Avoid calling stations at 15 and 45 minutes past the hour, because of interference with scheduled weather broadcasts.

6. When making a position report, pilots should in all cases state the name of the reporting point over which, or in relation to which, they are reporting. The phrase "OVER YOUR STATION" should not be used.

PROCEDURE WORDS AND PHRASES

1. The following words and phrases should be used where practicable in radiophone communications:

Word or Phrase	Meaning
ACKNOWLEDGE	"Let me know that you have received and understood this message."
AFFIRMATIVE	"Yes."
CORRECTION	"An error has been made in this transmission. The correct version is . . ."
GO AHEAD	"Proceed with your message."
HOW DO YOU HEAR ME?	Self-explanatory.
I SAY AGAIN	Self-explanatory.
NEGATIVE	"That is not correct."
OUT	"This conversation is ended and no response is expected."
OVER	"My transmission is ended and I expect a response from you."
READ BACK	"Repeat all of this message back to me."
ROGER	"I have received all of your last transmission." (To acknowledge receipt, shall not be used for other purposes.)
SAY AGAIN	Self-explanatory.
SPEAK SLOWER	Self-explanatory.
STAND BY	"If used by itself means 'I must pause for a few seconds.' If the pause is longer than a few seconds, or if 'STAND BY' is used to prevent another station from transmitting, it must be followed by the ending 'OUT'."
THAT IS CORRECT	Self-explanatory.
VERIFY	"Check with originator."
WORDS TWICE	(a) As a request: "Communication is difficult. Please say every phrase twice." (b) As information: "Since communication is difficult, every phrase in this message will be spoken twice."

TIME

1. The Federal Aviation Agency utilizes Greenwich Mean Time (GMT or "Z") for all operational purposes. Pilots are encouraged also to use GMT for aeronautical operational purposes; however, FAA facilities will accept local time if the pilot so desires.

To Convert From:	To Greenwich Mean Time:
Eastern Standard Time	Add 5 hours
Eastern Daylight Time	Add 4 hours
Central Standard Time	Add 6 hours
Central Daylight Time	Add 5 hours
Mountain Standard Time	Add 7 hours
Mountain Daylight Time	Add 6 hours
Pacific Standard Time	Add 8 hours
Pacific Daylight Time	Add 7 hours

2. The 24-hour clock system is used in radiotelephone transmissions. The hour is indicated by the first two figures and the minutes by the last two figures.

Examples:

0000 ------------------ZERO ZERO ZERO ZERO
0920 ------------------ZERO NINER TWO ZERO

3. Time may be stated in minutes only (two figures) in radio telephone communications when no misunderstanding is likely to occur.

4. Current time in use at a station is stated in the nearest quarter minute in order that pilots may use this information for time checks. Fractions of a quarter minute less than eight seconds are stated as the preceding quarter minute; fractions of a quarter minute of eight seconds or more are stated as the succeeding quarter minute.

Examples:

Time

0929:05 ----TIME, ZERO NINER TWO NINER
0929:10 ----TIME, ZERO NINER TWO NINER AND ONE-QUARTER
0929:28 ----TIME, ZERO NINER TWO NINER AND ONE-HALF

FIGURES

1. Figures indicating hundred and thousands in round number, as for ceiling heights, and upper wind levels up to 9900 shall be spoken in accordance with the following examples:

500 ----------------------------FIVE HUNDRED
1300 -------ONE THOUSAND THREE HUNDRED
4500 -------FOUR THOUSAND FIVE HUNDRED
9900 ------NINER THOUSAND NINER HUNDRED

FIGURES (Con't)

2. Numbers above 9900 shall be spoken by separating the digits preceding the word "thousand." Examples:

10000 ---------------------ONE ZERO THOUSAND
13000 ---------------------ONE THREE THOUSAND
18500 --ONE EIGHT THOUSAND FIVE HUNDRED
27000 ---------------------TWO SEVEN THOUSAND

3. All other numbers shall be transmitted by pronouncing each digit.

Examples:

10 ---------------------------------------ONE ZERO
75 ---------------------------------------SEVEN FIVE
583 --------------------------------FIVE EIGHT THREE
1850 -------------------------ONE EIGHT FIVE ZERO
18143 ----------------ONE EIGHT ONE FOUR THREE
26075 ----------------TWO SIX ZERO SEVEN FIVE

The digit "9" shall be spoken "NINER".

4. When a radio frequency contains a decimal point, the decimal point is spoken as "POINT."

Examples:

122.1 ----------------ONE TWO TWO POINT ONE
126.7 ----------------ONE TWO SIX POINT SEVEN

(ICAO Procedures require the decimal point be spoken as "DECIMAL" and FAA will honor such usage by military aircraft and all other aircraft required to use ICAO Procedures.)

FLIGHT ALTITUDES

1. Up to but not including 18,000′ MSL—by stating the separate digits of the thousands, plus the hundreds, if appropriate.

Examples:

12,000 -------------------------ONE TWO THOUSAND
12,500 ---ONE TWO THOUSAND FIVE HUNDRED

2. At and above 18,000′ MSL (FL 180) by stating the words "flight level" followed by the separate digits of the flight level.

Examples:

190 ----------FLIGHT LEVEL ONE NINER ZERO
275 -----------FLIGHT LEVEL TWO SEVEN FIVE

PHONETIC ALPHABET

1. Phonetic letter equivalents are communications safety tools to be used only when receiving conditions are such that the information cannot be readily received without their use. Under such adverse communications, phonetic equivalents are employed for single letters, or to spell out group of letters or difficult words.

2. The International Civil Aviation Organization (ICAO) phonetic alphabet is normally used by FAA personnel. However, different phonetic equivalents may be used by pilots, or, upon the pilot's request may be used by FAA during communications with such pilots.

A	● ▬	Alfa	(AL-FAH)
B	▬ ● ● ●	Bravo	(BRAH-VOH)
C	▬ ● ▬ ●	Charlie	(CHAR-LEE) (or SHAR LEE)
D	▬ ● ●	Delta	(DELL-TAH)
E	●	Echo	(ECK-OH)
F	● ● ▬ ●	Foxtrot	(FOKS-TROT)
G	▬ ▬ ●	Golf	(GOLF)
H	● ● ● ●	Hotel	(HOH-TEL)
I	● ●	India	(IN-DEE-AH)
J	● ▬ ▬ ▬	Juliett	(JEW-LEE-ETT)
K	▬ ● ▬	Kilo	(KEY-LOH)
L	● ▬ ● ●	Lima	(LEE-MAH)
M	▬ ▬	Mike	(MIKE)
N	▬ ●	November	(NO-VEM-BER)
O	▬ ▬ ▬	Oscar	(OSS-CAH)
P	● ▬ ▬ ●	Papa	(PAH-PAH)
Q	▬ ▬ ● ▬	Quebec	(KEH-BECK)
R	● ▬ ●	Romeo	(ROW-ME-OH)
S	● ● ●	Sierra	(SEE-AIR-RAH)
T	▬	Tango	(TANG-GO)
U	● ● ▬	Uniform	(YOU-NEE-FORM) (or OO-NEE-FORM)
V	● ● ● ▬	Victor	(VIK-TAH)
W	● ▬ ▬	Whiskey	(WISS-KEY)
X	▬ ● ● ▬	Xray	(ECKS-RAY)
Y	▬ ● ▬ ▬	Yankee	(YANG-KEY)
Z	▬ ▬ ● ●	Zulu	(ZOO-LOO)
1	● ▬ ▬ ▬ ▬	Wun	
2	● ● ▬ ▬ ▬	Too	
3	● ● ● ▬ ▬	Tree	
4	● ● ● ● ▬	Fow-er	
5	● ● ● ● ●	Fife	
6	▬ ● ● ● ●	Six	
7	▬ ▬ ● ● ●	Sev-en	
8	▬ ▬ ▬ ● ●	Ait	
9	▬ ▬ ▬ ▬ ●	Nin-er	
0	▬ ▬ ▬ ▬ ▬	Zero	

• AERONAUTICAL INFORMATION AND THE NATIONAL SYSTEM

1. Aeronautical information concerning the National Airspace System is disseminated by three methods. The primary method is aeronautical charts. The second method is the Airman's Information Manual (AIM), and the third is the National Notice to Airmen System. These three systems have been designed to supplement and complement each other. The basic difference between these three systems is the frequency of issuance. To the maximum extent possible, aeronautical charts reflect the most current information available at time of printing. The AIM contains static procedural data and data changes known sufficiently in advance to permit publication.

2. Information of a time-critical nature that is required for flight planning and not known sufficiently in advance to permit publication on a chart or in the AIM receives immediate handling through the National Notice to Airmen System.

3. Information distributed by the Notice to Airmen System is categorized into two types—NOTAMs and Airmen Advisories. It is the intent, insofar as possible, to limit to dissemination by NOTAM that time-critical information which would affect a pilot's decision to make a flight; for example, an airport closed, terminal radar out of service, en route navigational aids out of service, etc. Dissemination of information in this category will include that pertaining to all navigational facilities and all IFR airports with approved instrument approach procedures and for those VFR airports which are designated as the destination point on a daily average of two or more general aviation VFR flight plans. All such airports are annotated in Sections IV and IV–A of this manual by the section symbol "§" and are primarily those airports having an assigned three letter location identifier.

4. Information which is primarily of an advisory or "nice-to-know" nature, plus data on airports not included above, that can be given to the pilot upon request on an "as-needed" basis before departure, while en route, or prior to landing, is classed as an Airmen Advisory and given local distribution via appropriate voice communications, local teletypewriter or telautograph circuits, telephone, etc. Examples of this type are: Men and equipment crossing a runway, snowbanks off the sides of the runways, taxiway closed, etc.

5. Pilots planning a flight should contact the nearest FAA Flight Service Station to obtain current flight information.

THE NOTAM CODE

INTRODUCTION

The NOTAM Code provides for coding NOTAM information to reduce telecommunications transmission time and reduce translation difficulties in the International Service.

A NOTAM Code group contains 5 letters. The first letter is always the letter Q to indicate a code abbreviation for use in the composition of NOTAMs. The letter Q has been chosen to avoid conflict with any assigned radio call sign.

NOTAM code significations shall be amplified or completed where necessary by adding appropriate words, contractions, frequencies, location identifiers, place names, or figures. Approved abbreviations shall be used in preference to plain language whenever possible. The information necessary to complete a NOTAM code group, as indicated by a blank space, shall be given except when (1) the blank spaces are enclosed within parentheses or brackets to indicate their completion is optional; e.g., LHX QIEIK 15 MIN. Meaning: the LaJunta Colorado airport beacon is available on request at 15 minutes' notice; or (2) an alternative meaning shown in parentheses is selected and the blank space in this alternative meaning is complete; e.g., QAPOK 116.9. Meaning: the radio range on 116.9 Mc. resumed normal operation.

Expressions or words in parentheses which do not include blank spaces have the following significances:

(1) When following a blank space, signifies the explanation of information to be used in filling the preceding blank.

(2) When following a word or expression, signifies an alternative to the word or expression.

CODE GROUP FORMATION

5-letter NOTAM code groups are formed in the following manner:

(1) First Letter.—The letter Q.

(2) Second and Third Letters.—The appropriate combination of 2 letters, selected from the "2nd and 3rd letters" section of the code, identify the facility, service or danger to aircraft in flight being reported. The *second* letter has been restricted to A, E, I, O, or U. These letters also serve to classify the aid, facility, or service described: i.e., the letters A and E signify radio aids. The letter I signifies lighting facilities. The letters O and U signify airports, search and rescue, and dangers to aircraft in flight.

(3) Fourth and Fifth Letters.—The appropriate cominbation of 2 letters, selected from the "4th and 5th Letters" section, denote the operating status of the facility, service, or danger to aircraft being reported. The *fourth* letter has been restricted to A, E, I, O, or U.

DECODE

SECOND AND THIRD LE

SIGNIFICATION	2nd & 3rd Letters
RADIO AIDS	
. . . [*specify TWR, APP, ACC or FIC*] air traffic services receiver . . . kc/s. (*or* . . . Mc/s.).	AY AZ
Inner marker, Instrument Landing System.	EA EB
. . . [*specify TWR, APP, ACC or FIC*] air traffic services transmitter . . . kc/s. (*or* . . . Mc/s.).	EC ED EE
Middle marker, Instrument Landing System.	EF
Outer marker, Instrument Landing System.	EG EH
Fan-type marker.	
Glide path, Instrument Landing System.	EI
Non-directional Beacon (NDB).	EJ
Instrument Landing System (ILS).	EK
Radio range (other than VOR) and associated voice communications.	EL
Radio receiving facilities.	EM
Localizer, Instrument Landing System.	EN
Locator, inner, Instrument Landing System.	EO
TACAN.	
Locator, outers, Instrument Landing System.	EP EQ
VOR (VHF Omnidirectional Radio Range) and associated voice communications.	ER ES
VOR (VHF Omnidirectional Radio Range).	ET
Radio range (other than VOR).	
Radio range leg.	EU
Attentional signal.	
Meteorological communications . . . kc/s. (*or* . . . Mc/s.).	EV
Voice communications . . . kc/s. (*or* . . . Mc/s.).	EW
Unassigned.	EX
Non-directional Beacon (NDB) and voice facility.	EY EZ

LIGHTING FACILITIE	
Boundary lights.	ID
Aerodrome beacon.	IE
Unassigned.	IF

DECODE

SECOND AND THIRD LETTE

SIGNIFICATION	2nd & 3rd Letters
LIGHTING FACILITIES (	
Angle-of-approach lights.	IP
Taxiway lights.	
Hazard beacon.	
Threshold lights (for runway number . . .).	IQ IR
Flares.	
All landing area lighting facilities.	IS
Identification beacon.	
Unassigned.	IT–IY IX
Obstruction lights.	IZ

AERODROMES — SEARCH AN
DANGERS TO AIRCRAFT I

Land aerodrome.	UB
Beaching facilities.	UC
Water aerodrome.	UD
Meteorological forecast service.	
Meteorological observation service.	
Meteorological watch service.	UE
Runway arresting gear.	UF
Helicopter landing area.	UG
Unassigned.	
All runways [except number(s) . . .].	UH
Stopway for runway number.	UI
Taxiway(s).	UJ
Rescue vessel.	UK
Ocean Station Vessel.	UL
Refueling [. . . type fuel(s) *or* . . . octane].	UM UN
Search and rescue aircraft [*specify VLR, LRG, MRG, SRG or HEL*].	UO–UP UQ
Crash and fire fighting facilities.	UR
Unassigned	US
. . . [*specify TWR, APP, ACC or FIC*] air traffic service.	UT UU
	UV
Unassigned.	UW–
Warship.	UY
Alighting area.	UZ

THE NOTAM COI

DECODE

FOURTH AND FIFTH LI

SIGNIFICATION	4th & 5th Letters
HAZARD OR STATUS OF OPERATION OR	
Unassigned.	EC
Usable for length of . . . and width of	
. . .	ED
Covered by snow to a depth of . . .	
NOTE.—*This snow is not compacted.*	
Cleared of soft snow, full length and	EE–EG
width.	EH
Totally free of snow and ice.	EI–EL
Covered by [. . . (*type*)] ice to a	EM
depth of . . .	EN
Unassigned.	
Operating without tone modulation.	
Operating without coding or flashing.	
Covered by compacted snow to a depth	EO
of . . .	EP
Operating on reduced power.	
Snow clearance in progress [estimated time of completion is . . .	EQ–ER
mated time of completion is . . .	ES
(*date/time*)].	
Grass cutting in progress [estimated	
time of completion is . . . (*date/*	
time)].	
	ET
Marked by . . .	
Work is in progress [estimated time	EU–EV
of completion is . . . (*date/time*)].	EW
Work completed.	EX
Snow clearance completed.	EY
Grass cutting completed.	
Sanding is in progress [estimated	EZ
time of completion is . . . (*date/*	
time)].	IA–IB
Appears unreliable.	IC
Covered by ice patches.	
Height of snowbanks is . . . (*figures*	
and units).	
Braking action is . . . (A = *good*,	ID
B = *medium*, C = *poor*).*	IE
Are to avoid area, radius of danger	IF
being . . . (about the point . . .).	IG–IJ
Will take place from . . . (*date/time*)	IK
for an unknown duration [*or* until	
. . . (*date/time*)] (on the days of	
. . . between the hours of . . . and	IL
. . .) at . . . (*location*) (within the	IM
sector of . . . and a radius of . . .)	IN
at . . . height above . . . (*datum*).	
Unassigned.	
Location change to . . . effective . . .	
(*date/time*).	IO

s type of acft or vehicle making report.

DECODE

FOURTH AND FIFTH LETTEI

SIGNIFICATION	4th & 5th Letters
HAZARD OR STATUS OF OPERATION OR CON	
Track(s) reported to be displaced (. . . degrees) (. . . direction) of published bearing(s), other tracks probably have shifted.	OV– OW OX
To be used as radio beacon only.	
Magnetic track(s) towards station is are now . . . [will be . . . at . . . (*date/time*)].	OY– OZ UA
Operative (or *re*-operative) subject to conditions/limitations already published.	
Aircraft restricted to runways and taxiways.	UB—UC UD
Unserviceable for aircraft heavier than . . . tons.	
Unsafe from . . . (*date/time*) for an unknown duration [*or* until . . . (*date/time*)].	UE UF
Unassigned.	UG
Unassigned.	
Operative but ground checked only, awaiting flight check.	
Unassigned.	UH
Resumed normal operation.	
Track(s) ground checked, approved for instrument flying.	UI
Shut down for maintenance from . . . (*date/time*) for an unknown duration [*or* until . . . (*date/time*)]—disregard all signals.	UJ—UL UM UN—US
Unassigned.	UT
Previously promulgated shutdown has been cancelled.	
Unassigned.	UU
New facility in operation.	
Operating without interruption for voice transmissions from . . . (*date/time*) for an unknown duration [*or* until . . . (*date/time*)].	UV UW UX– UZ

ALTIMETRY

GENERAL

1. The accuracy of aircraft altimeters is subject to the following factors: (a) nonstandard temperature of the atmosphere; (b) aircraft static pressure systems (position error); and (c) instrument error. Pilots should disregard the effect of nonstandard atmospheric temperatures except that low temperatures need to be considered for terrain clearance purposes.

NOTE.—Standard temperature at sea level is 15° C. (59° F.). The temperature gradient from sea level is 2° C. (3.5° F.) per 1000 feet. Pilots should apply corrections for static pressure systems and/or instruments, if appreciable errors exist.

2. Experience gained with the present volume of operations has led to the adoption of a standard altimeter setting for flights operating in the higher altitudes. A standard setting eliminates altitude conflicts caused by altimeter settings derived from different geographical sources. In addition, it eliminates station barometer errors and some of the altimeter instrument errors. The following outlines the current procedures in effect:

a. The cruising altitude or flight level of aircraft shall be maintained by reference to an altimeter which shall be set, when operating:

(1) **Below 18,000 feet MSL**—to the current reported altimeter setting of a station along the route and within 100 nautical miles of the aircraft; or, if there is no station within this area, to the current reported altimeter setting of an appropriate available station. In the case of an aircraft not equipped with a radio, set to the elevation of the departure airport or use an appropriate altimeter setting available prior to departure.

(2) **At or above 18,000 feet MSL (FL 180)**—to 29.92" Hg (standard setting).

NOTE.—The lowest usable flight level is determined by the atmospheric pressure in the area of operation, as shown in the following table:

Altimeter Setting (Current Reported)	Lowest usable flight level
29.92 or higher	180
29.91 to 29.42	185
29.41 to 28.92	190
28.91 to 28.42	195
28.41 to 27.92	200

(3) Where the minimum altitude, as prescribed in FAR Parts 91.79 and 91.119, is above 18,000 feet M.S.L. the lowest usable flight level shall be the flight level equivalent of the minimum altitude plus the number of feet specified in the following table:

Altimeter Setting	Correction Factor
29.92 or higher	None
29.91 to 29.42	500 feet
29.41 to 28.92	1000 feet
28.91 to 28.42	1500 feet
28.41 to 27.92	2000 feet
27.91 to 27.42	2500 feet

NOTE.—For example, the minimum safe altitude of a route is 19,000 feet MSL and the altitmeter setting is reported between 29.92 and 29.42 Hg., the lowest usable flight level will be 195, which is the flight level equivalent of 19,500 feet M.S.L. (minimum altitude plus 500 feet).

ALTIMETER SETTING SERVICE

1. Aircraft on an IFR flight plan and in direct communication with the Air Route Traffic Control Center (ARTCC) will be issued altimeter settings by the ARTCC as follows:

a. En route aircraft will be given the altimeter setting for the weather reporting station associated with a navigational aid designated as a compulsory reporting point with the appropriate center's area of jurisdiction, at the time the position report is acknowledged.

b. Aircraft departing a terminal area are normally provided an altimeter setting prior to departure. However, if such aircraft are required to remain in direct comunication with a Center, they will be given altimeter settings in accordance with paragraph a. above, when they are beyond 50 nautical miles of the point of departure.

c. Aircraft destined for a terminal within a Center's control area will be given the destination terminal altimeter setting, if available, when approximately 50 nautical miles from destination. Thereafter, additional altimeter setting service in accordance with paragraph a. above, normally will not be provided.

d. Pilots of aircraft operating below Flight Level 180, who have been advised to omit position reports, will be furnished the appropriate altimeter setting when passing compulsory reporting points as observed by radar.

e. Available altimeter settings will be furnished for any other weather reporting stations within a Center's control area if requested by a pilot. Requests for altimeter settings outside of a Center's control area will normally be referred to the appropriate communications facility.

f. When providing altimeter setting service, Centers will use the following phraseology:

"THE (Time) (Station Location) ALTIMETER (Setting)"

Example:

"THE ONE FOUR ONE FIVE COLUMBUS ALTIMETER THREE ZERO ZERO ZERO."

g. Altimeter settings will not be furnished aircraft that are maintaining flight levels except:

(1) When requested by the pilot.

(2) When a descent clearance is issued from flight level to cruising altitude.

2. Airport traffic control towers provide current altimeter settings:

a. To departing aircraft (IFR or VFR) unless the pilot has other preferred means of securing the setting.

b. To all arriving aircraft operating on IFR flight plans (except non-approach control towers when the approach clearance has been issued through another source);

c. Upon specific request of pilots.

3. Flight Service Stations issue current altimeter settings:

a. In scheduled weather broadcasts (15 and 45 minutes past the hour);

b. In terminating communications with aircraft operating below 18,000'.

c. Upon specific request.

WEATHER

GENERAL

1. The U.S. Weather Bureau maintains a comprehensive surface and upper air weather observing program and a nation-wide aviation weather forecasting and pilot briefing service.

2. Weather observations are made each hour or more often at over 600 locations in the United States. These observations may be used to determine the present weather conditions for flight planning purposes.

3. Every six hours the Weather Bureau's Aviation Forecasting Centers prepare detailed flying weather forecasts for 12-hour periods for about 385 air terminals in the United States including Alaska and Hawaii. In addition, 24-hour terminal forecasts are provided for about 120 major airports throughout the country. Every six hours a detailed 12-hour area forecast is prepared for each of the 29 areas into which the continental United States has been divided for forecasting purposes. In Hawaii, forecasts are issued for the main traveled air routes instead of areas. Winds aloft forecasts are provided for about 150 locations in the United States including Alaska and Hawaii for flight operational purposes. All of the above flying weather forecasts are given wide distribution via teletypewriter circuits.

4. Available aviation weather reports and forecasts are displayed at each Weather Bureau Station and FAA Flight Service Station. Pilots should feel free to help themselves to this information or to ask the assistance of the duty employee.

5. When telephoning for information, use the following procedures:

a. Identify yourself as a pilot and give aircraft identification if known. (Many persons calling WB stations want information for purposes other than flying.)

b. State your intended route, destination, proposed departure time, and estimated time en route.

c. Advise if prepared to fly IFR.

6. Direct pilot-to-weather briefer service is available by radio contact with any Flight Service Station operated by the FAA. Flight Service Specialists are qualified and certificated by the USWB as Pilot Weather Briefers. They are not authorized to make original forecasts but are authorized to adapt, translate and interpret available forecasts and reports directly into terms of the weather conditions which you can expect along your flight route and at destination. They also will assist you in selecting an alternate course of action in the event adverse weather is encountered. It is not necessary to be thoroughly familiar with the standard phraseologies and procedures for air/ground communications. A brief call stating your message in your own words will receive immediate attention.

TRANSCRIBED WEATHER BROADCASTS

1. Equipment is provided at selected FAA FSSs by which meteorological and Notice to Airmen data is recorded on tapes and broadcast continuously over the low-frequency (200–415 kc) navigational aid (L/MF range or H facility).

2. Broadcasts are made from a series of individual tape recordings. The first three tapes identify the station, give general weather forecast conditions in the area, pilot reports (PIREP), radar reports when available, and winds aloft data. The remaining tapes contain weather at selected locations within a 400-mile radius of the central point. Changes, as they occur are transcribed onto the tapes.

3. Automatic transcribed broadcasts service is available on class H facilities designated as:

a. **HSAB**—A class H radio beacon required for IFR radio navigation and/or airtraffic control and for automatic transcribed weather broadcast service. This class facility will be depicted on radio facility, Sectional and WAC type charts.

b. **SABH**—A class H radio beacon having limited navigational use in that it is not flight inspected for IFR certification or primarily used for air traffic control. This aid will provide the automatic transcribed weather broadcast service and will be depicted on Sectional and WAC type charts, only.

4. Operation of either type facility will be essentially the same. Both will have a code identification sent at frequency intervals keyed simultaneously with the voice signals. Although, not essential, it may be advantageous to listeners to equip their receivers with a 1020 cycle code rejection filter which, when switched to the "voice" position, will silence the keyed code identification signal.

5. The AB (automatic transcribed service) component of HSAB's and SABH's will operate continuously except during those periods when the transcription equipment is inoperative. During these periods manual broadcasts, scheduled (H+45 hourly) and non-scheduled will be made.

SCHEDULED WEATHER BROADCASTS

1. All Flight Service Stations having voice facilities on continuously operated radio ranges or radio beacons broadcast weather reports and other airway information at 15 and 45-minutes past each hour. The 45-minute past the hour broadcast is an "airway" broadcast consisting of weather reports from important terminals located on airways within approximately 400 miles of the broadcasting station. The 15-minute past the hour broadcast is an "area" broadcast consisting of weather

SCHEDULED WEATHER BROADCASTS (Con't)

reports from the stations within approximately 150 miles of the broadcasting station.

2. At each station, the material broadcast on schedule and the order in which it is broadcast follows:

a. Alert notice announcement.

b. SIGMET (Significant Meterology) or Advisory for Light Aircraft (if available).

c. Pilot report/s when available.

d. Radar report/s if available.

e. Aviation weather.

f. Flight information—any non-meteorological information not a part of a weather report but which requires broadcast.

g. Additional special weather reports and some Notice to Airmen data are broadcast off-schedule upon receipt.

NOTE.—Winds aloft forecast will be transmitted only on pilot's request.

3. The time of observation of weather reports included in a scheduled broadcast normally is 58 minutes past the hour preceding the broadcast. When the time of observation is otherwise, the observation time is given.

WEATHER BROADCAST FORMAT

1. SCHEDULED WEATHER BROADCASTS

a. Scheduled Weather Broadcast (15 and 45 minutes past each hour): Each broadcast begins with the announcement of the station name, the time the broadcast is started, spoken in two digits or two digits and a fraction, and the title "Aviation Weather."

Example:

This is (station name), time one five (or one five and one quarter; one five and one half, etc.), aviation weather.

b. The reporting location name is spoken twice; except in transcribed weather broadcasts the location name of selected weather reports is announced only once on recording tapes.

2. UNSCHEDULED BROADCASTS

a. The data being broadcast is identified immediately following the station name. The time is announced as specified above for scheduled broadcasts. The reporting location name is spoken twice, followed by the time of observation of special (SPL) weather reports stated in two digits indicating minutes only.

Examples:

This is (station name) time three niner, Special Weather Report (location name, spoken twice) three seven observation.

This is (station name) time two niner, Notice to Airmen (location name spoken twice).

IN-FLIGHT WEATHER ADVISORIES

1. The U.S. Weather Bureau issues in-flight safety advisories, in the 48 contiguous States, designated as SIGMETs and AIRMETs.

2. The purpose of this service is to make available to any aircraft in-flight information on weather which may be hazardous to the flight. Whether or not the condition described is potentially hazardous to a particular flight is for the pilot himself to evaluate on the basis of his own experience and the operational limits of his aircraft.

3. SIGMET advisories include weather phenomena potentially hazardous to *all* aircraft, specifically:

a. Tornadoes.

b. Line of thunderstorms (squall lines).

c. Hail ¾" or more.

d. Severe and extreme turbulence.

e. Heavy icing.

f. Widespread duststorms/sandstorms, lowering visibilities of less than two miles.

4. AIRMETs (formerly designated "Advisories for Light Aircraft") include weather phenomena of less severity than that covered by SIGMETs which are potentially hazardous to aircraft having limited capability because of lack of equipment or instrumentation, or pilot qualifications and are at least of operational interest to *all* aircraft, specifically:

a. Moderate icing.

b. Moderate turbulence.

c. The initial onset of phenomena producing extensive areas of visibilities less than two miles or ceilings less than 1000 feet, including mountain ridges and passes, and winds of 40 knots or more within 2000 feet of the surface.

NOTE.—SIGMETs apply to *all categories of aircraft*. When SIGMET and AIRMET weather categories apply simultaneously for approximately the same area, AIRMET information is appended to the SIGMET as an "additional AIRMET" advisory.

5. Identification of SIGMETs and AIRMETs—Advisories are identified by a letter and number beginning each midnight local standard time (LST) in the Flight Advisory Service (FAWS) office where issued. The first Advisory, SIGMET or AIRMET, is identified as "Alfa 1" and each succeeding *related* advisory retains the same letter designator but is given the next number, i.e., "Alfa 2," "Alfa 3," etc. If a SIGMET or AIRMET condition develops in a second distinctly separate sector of the FAWS area, the advisory is identified as "Bravo 1," "Bravo 2," etc. Similarly, a third area is identified as "Charlie 1," "Charlie 2," etc.

6. The following are examples of a SIGMET, AIRMET, and a combination of the two:

a. KANSAS CITY SIGMET ALFA 2. SOLID LINE THUNDERSTORMS 50 MILES WIDE FROM WEST OF GRAND ISLAND NEBRASKA TO HILL CITY TO GARDEN CITY AT 1400 CST MOVING EAST AT 35 KNOTS REACHING LINCOLN-SALINA-HUTCHINSON LINE BY 1900 CST. THUNDERSTORMS LOCALLY SEVERE WITH TOPS TO 45 THOUSAND.

b. MEMPHIS AIRMET BRAVO 1. TENNESSEE SOUTH OF LINE FROM DYERSBURG TO NASHVILLE TO CROSSVILLE CONDITIONS LOWERING RAPIDLY IN RAIN AND FOG TO BELOW 1 THOUSAND FEET AND BELOW 2 MILES BY NOON WITH HIGHER TERRAIN OBSCURED. CONDITIONS CONTINUING BEYOND 1400 CST.

c. WASHINGTON AIRMET ALFA 1 CANCELED. SIGMET ALFA 2. MODERATE OR MORE CLEAR AIR TURBULENCE EXTENDING FROM SOUTH CENTRAL VIRGINIA THROUGH DELAWARE AT 14 THOUSAND TO 24 THOUSAND FEET CONTINUING TO 0800 EST OR LATER. ADDITIONAL AIRMET. OVER EASTERN VIRGINIA EASTERN MARYLAND AND DELAWARE MODERATE ICING 2 THOUSAND TO 8 THOUSAND FEET DECREASING BUT WITH WINDS LOWER LEVELS BECOMING 40 TO 50 KNOTS BY 0800 EST WITH MODERATE TURBULENCE.

IN-FLIGHT WEATHER ADVISORIES (Con't)

7. FAA flight service stations (FSSs) broadcast SIGMETs and AIRMETs during their valid period when they pertain to the area within 150 NM of the FSS as follows:

a. SIGMETs—At 15 minute intervals: H+00, H+15*, H+30, and H+45*; AIRMETs—At 30 minute intervals: H+15* and H+45*.

*Included in the regular scheduled broadcasts.

PILOT WEATHER REPORTS (PIREPS)

1. Whenever ceilings at or below 5,000 feet, visibilities at or below five miles, or thunderstorms are reported or forecast, FAA Stations are required to solicit and collect PIREPS which describe conditions aloft. Pilots are urged to cooperate and volunteer reports of cloud tops, upper cloud layers, thunderstorms, ice, turbulence, strong winds, and other significant flight condition information. Such conditions observed between weather reporting stations are vitally needed. The PIREPS should be given to the FAA ground facility with which communication is established, i.e., FSS or Air Route Traffic Control Center. In addition to complete PIREPS, pilots can materially help round out the in-flight weather picture by adding to routine position reports, both VFR and IFR, the following phrases as appropriate:

ON TOP
BELOW OVERCAST
WEATHER CLEAR
MODERATE (or HEAVY) ICING
MODERATE, SEVERE, EXTREME TURBULENCE
FREEZING RAIN (or DRIZZLE)
THUNDERSTORM (location)
BETWEEN LAYERS
ON INSTRUMENTS
ON AND OFF INSTRUMENTS

2. If pilots are not able to make PIREPS by radio, reporting upon landing of the in-flight conditions encountered to the nearest Flight Service Station or Weather Bureau Airport Station will be helpful. Some of the uses made of the reports are:

a. The airport traffic control tower uses the reports to expedite the flow of air traffic in the vicinity of the field and also forwards reports to other interested offices.

b. The Flight Service Station uses the reports to brief other pilots.

c. The local Weather Bureau Office uses the reports in briefing other pilots and in forecasting.

d. The Air Route Traffic Control Center uses the reports to expedite the flow of en route traffic and determine most favorable altitudes.

e. The Weather Bureau Flight Advisory Weather Service finds pilot reports very helpful in issuing advisories of hazardous weather conditions. This office also uses the reports to brief other pilots, and in forecasting.

CLEAR AIR TURBULENCE (CAT)

Clear air turbulence (CAT) has become a very serious operational factor to flight operations at all levels and especially to jet traffic flying in excess of 18,000 feet. The best available information on this phenomena must come from pilots via the PIREPS procedures. All pilots encountering CAT conditions are urgently requested to report *time, location* and *nature* (moderate, severe or extreme) of the element to the FAA facility with whom they are maintaining radio contact. If time and conditions permit, elements should be reported according to the standards for other PIREPS and position reports. For consistent identification of the degree of turbulence, U.S. Standard Turbulence Criteria Table states:

Light—Loose objects in aircraft remain at rest.

Moderate—Seat-belts required. Unsecured objects move about.

Severe—Occupants thrown violently against seat-belts. Momentary loss of aircraft control. Unsecured objects tossed about.

Extreme—Aircraft is violently tossed about, impossible to control. May cause structural damage.

REPORTING OF CLOUD HEIGHTS

1. Ceiling, by definition in Part I Federal Aviation Regulations, and as used in Aviation Weather Reports and Forecasts, is the height *above ground (or water) level* of the lowest layer of clouds or obscuring phenomenon that is reported as "broken", "overcast", or "obscuration" and not classified as "thin" or "partial". For example, a forecast which reads "CIGS WILL BE GENLY 1 TO 2 THSD FEET" refers to heights *above ground level* (AGL). On the other hand, a forecast which reads "BRKN TO OVC LYRS AT 8 TO 12 THSD MSL" states that the height is *above mean sea level* (MSL).

2. Pilots usually report height values above mean sea level, since they determine heights by the altimeter. This is taken in account when disseminating and otherwise applying information received from pilots. ("Ceilings" are always heights above ground level.) In reports disseminated as PIREPS, height references are given the same as received from pilots, that is above mean sea level (MSL or ASL). In the following example, however, a pilot report of the heights of the bases and tops of an overcast layer in the terminal area is used in two ways in a surface aviation weather report:

A12⊕2FK 132/49/47/0000/ØØ2/⊕23

3. In this example the weather station has converted the pilot's report of the height of base of the overcast from the height (MSL) indicated on the pilot's altimeter to height above ground and has shown by the prefix "A" that the ceiling height was determined by an aircraft. The height of cloud tops shown in remarks (⊕23) is *above mean sea level* (ASL or MSL) as initially reported by the pilot.

4. In aerial forecasts (Regional, Area, or In-flight Advisories), ceilings are denoted by the prefix "C" when used with sky cover symbols as in "LWRG TO C5⊕1TRW", or by the contraction "CIG" before, or the contraction "AGL" after, the forecast cloud height value. When the cloud base is given in height above mean sea level, it is so indicated by the contraction "MSL" or "ASL" following the height value. The heights of cloud tops, freezing level, icing and turbulence are always given in heights above mean sea level (ASL or MSL).

5. Attention is invited to the Weather Bureau publication "Key to Aviation Weather Reports and Forecasts." This is an easy-reference card which explains how to

REPORTING OF CLOUD HEIGHTS *(Con't)*

read aviation weather reports and forecasts and how ceiling and cloud heights are identified. This card can be obtained from the nearest USWB office or from the USWB, Washington, D.C. (See sample card on page I-32.)

VISIBILITY OBSERVATIONS

1. Recent advances in meteorological measuring and reporting techniques have resulted in the use of new terminology in presenting visibility. In an attempt to clarify the differences between the various terms currently in use, a brief synopsis of each is presented below.

a. **Prevailing Visibility** is the greatest horizontal distance at which targets of known distance are visible over at least half of the horizon. It is normally determined by an observer on or close to the ground viewing buildings or other similar objects during the day and ordinary city lights at night. Under low visibility conditions the observatons are usually made at the control tower. Visibility is reported in miles and fractions of miles in the Aviation Weather Report. If a single value does not adequately describe the visibility, additional information is reported in the "Remarks" section of the report.

b. **Runway Visibility Values (RVV)** is defined as the horizontal distance at which a stationary observer near the end of the runway can see an ordinary light (about 25 candlepower) at night or a dark object against the horizon sky in the day time. In practice the human observer is used very little for this observation. Instead runway visibility is normally determined by a transmissometer (a photoelectric device calibrated in terms of a human observer). It is reported in miles and fractions of miles in the "Remarks" section of the Aviation Weather Report. A meter in the control tower gives the FAA traffic controller a continuous indication of the runway visibility at transmissometer locations. Runway visibilty, where avalable, may be used in place of prevailing visibility for the determination of minimums on the transmissometer runway. This program is gradually being replaced by Runway Visual Range at transmisometer locations.

c. **Runway Visual Range** (RVR) is an instrumentally derived value, based on standard calibrations, that represents the horizontal distance a pilot will see down the runway from the approach end; it is based on the sighting of either high intensity runway lights or on the visual contrast of other targets—whichever yields the greater visual range. RVR, in contrast to prevailing or runway visibility, is based on what a pilot in a moving aircraft should see looking down the runway. RVR is horizontal, AND NOT SLANT, visual range. It is based on the measurement of a transmissometer made near the touchdown point of the instrument runway and is reported in hundreds of feet. At the present time, RVR observations are automatically furnished to FAA tower controllers at approximately 40 locations from read-out equipment connected to the remote transmissometer installation. RVR provides an additional operating minimum at fields equipped with specified navigational aids. For example, at the present time the RVR minimum at Newark is 2000 feet (in combination with a minimum descent altitude of 218′ MSL) for both takeoffs and landings regardless of the reported ceilings and visibility.

Detailed explanatory information on runway visiblity and runway visual range is published in FAA Advisory Circular AC 00–13.

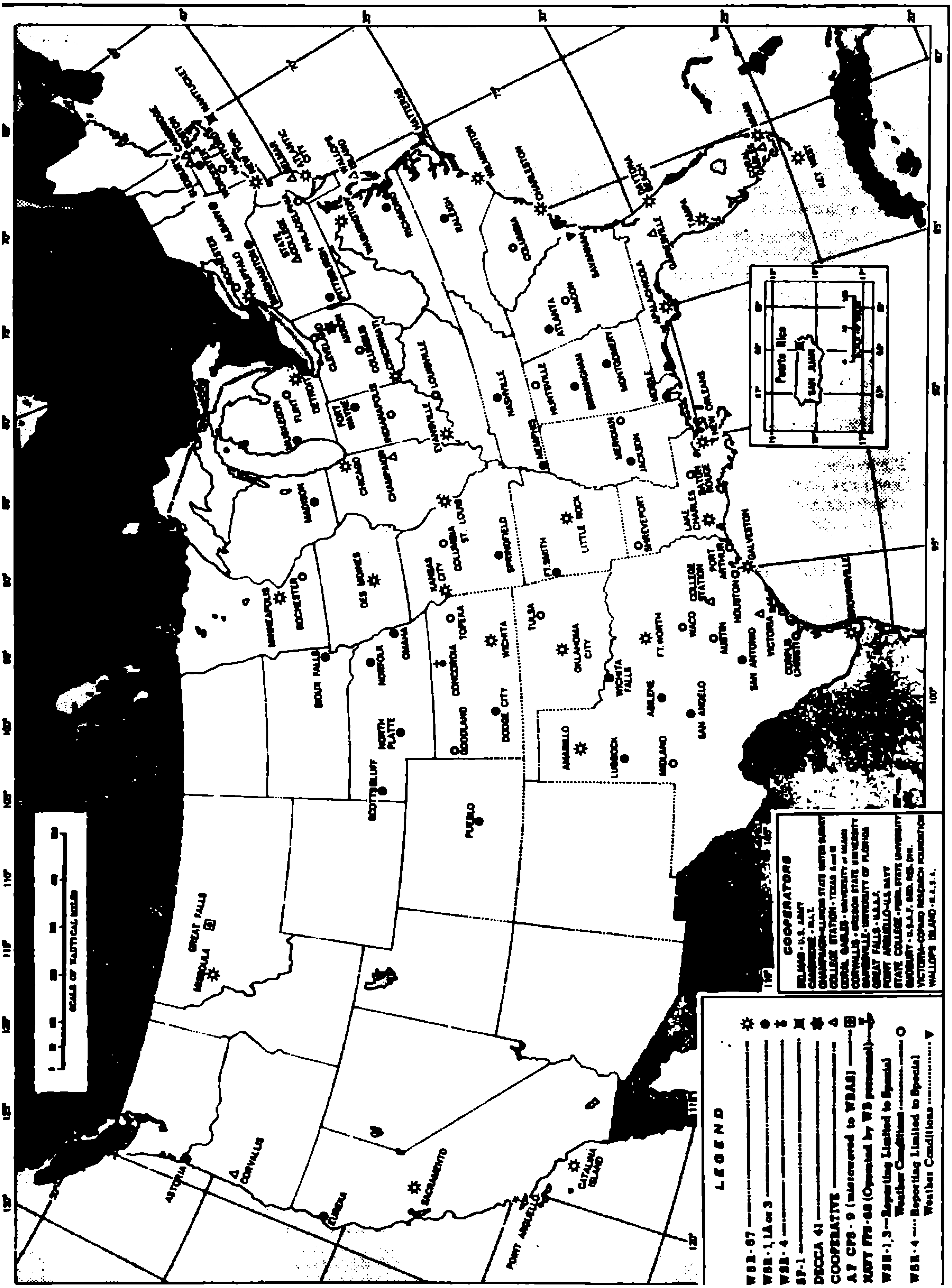
WEATHER RADAR

1. The U.S. Weather Bureau operates a 97-station net work (see chart on page I-31) of weather radars which are operated continuously if any precipitation capable of being detected is present or expected. These stations are generally spaced in such a manner as to enable them to detect and identify the type (snow, rain) of most of the precipitation east of the Continental Divide.

2. If any weather is detected, a scheduled radar observation is taken at 45 minutes past each hour—more often if the characteristics (speed, intensity, etc.) of the detected echoes are changing rapidly, except as noted in the legend of the chart. These observations are transmitted to many Weather Bureau and FAA stations and are available for use in pre-flight and in-flight planning. In addition, an hourly plain language radar summary and a three-hourly radar summary facsimile chart are prepared by the Radar Analyses and Development Unit in Kansas City, Missouri. The hourly radar summary is transmitted on Service A teletypewriter to all Weather Bureau and Flight Service Stations, and the radar chart is available to all subscribers to the facsimile network.

3. Briefly, these observations are encoded in a self-evident code. The echo coverage (scattered, broken, etc.) is determined by a comparison of the relative amount of echo as compared to the total area outlined by the position groups. The number of tenths of coverage for each category is the same as those contained in Circular N for sky condition symbols (e.g., scattered means 1/10 to 5/10 coverage). Intensity of an echo is determined on the basis of returned signal strength and range of the echo. The more intense the echo, the more likely it is to be associated with severe weather. Location of salient points of echoes is given relative to the station. The azimuth is in degrees true, and the distance in nautical miles. Direction and speed of movement are given to 16 points of the compass and in knots, respectively, with direction referring the direction from which the echo is moving. Values of echo tops refer to the uppermost limit of precipitation that may be detected by radar and are not the actual tops of visible clouds. "Hook" echoes are usually associated with tornadoes and "spiral bands" with hurricanes .

4. Many of the stations equipped with radar have a radar repeaterscope near the briefing display that is available for viewing. As a radar can provide a comprehensive area picture of the weather within its range, viewing this scope can help your flight planning. It can show the exact location and extent of storms and the briefer can give you the direction and speed of movement, as well as height and intensity of these echoes. Technical considerations prevent dependable determinations of echo intensity beyond 100 nautical miles although storms of considerable height and intensity can be seen at ranges greater than 100 nautical miles. In order to obtain optimum benefit from radar data, it is suggested that an interpretation of the radarscope be obtained from Weather Bureau personnel who are trained in radar operation and scope interpretation.


LEGEND
WBR-57
WBR-1, 1A or 3
WBR-4
SP-1
DECCA 41
COOPERATIVE
AF CPS-9 (microwaved to WBAS)
NAVY FPS-68 (Operated by WB personnel)
WBR-1,3—Reporting Limited to Special Weather Conditions
WBR-4—Reporting Limited to Special Weather Conditions
COOPERATORS
SCALE OF NAUTICAL MILES
Puerto Rico
SAN JUAN
ASTORIA
CORVALLIS
EUREKA
SACRAMENTO
PORT ARGUELLO
CATALINA ISLAND
MISSOULA
GREAT FALLS
PUEBLO
SCOTTSBLUFF
NORTH PLATTE
GOODLAND
DODGE CITY
AMARILLO
LUBBOCK
MIDLAND
SAN ANGELO
ABILENE
WICHITA FALLS
SIOUX FALLS
NORFOLK
OMAHA
CONCORDIA
TOPEKA
WICHITA
OKLAHOMA CITY
TULSA
FT. WORTH
WACO
AUSTIN
SAN ANTONIO
VICTORIA
CORPUS CHRISTI
BROWNSVILLE
HOUSTON
GALVESTON
PORT ARTHUR
COLLEGE STATION
MINNEAPOLIS
ROCHESTER
DES MOINES
KANSAS CITY
COLUMBIA
ST. LOUIS
SPRINGFIELD
FT. SMITH
LITTLE ROCK
SHREVEPORT
LAKE CHARLES
BATON ROUGE
NEW ORLEANS
MADISON
CHICAGO
CHAMPAIGN
INDIANAPOLIS
EVANSVILLE
LOUISVILLE
NASHVILLE
MEMPHIS
JACKSON
MERIDIAN
HUNTSVILLE
BIRMINGHAM
MONTGOMERY
MOBILE
APALACHICOLA
ATLANTA
MACON
SAVANNAH
COLUMBIA
CHARLESTON
WILMINGTON
RALEIGH
HATTERAS
RICHMOND
WASHINGTON
PITTSBURGH
CLEVELAND
AKRON
COLUMBUS
CINCINNATI
DETROIT
FLINT
MUSKEGON
FORT WAYNE
BUFFALO
ROCHESTER
BINGHAMTON
ALBANY
STATE COLLEGE
PHILADELPHIA
ATLANTIC CITY
NEW YORK
NANTUCKET
DAYTONA BEACH
GAINESVILLE
TAMPA
MIAMI
CORAL GABLES
KEY WEST

THUNDERSTORMS

1. Every thunderstorm has turbulence, sustained updrafts and downdrafts, precipitation and lightning. Icing conditions and hail can frequently be expected.

2. The chances of severe or extreme turbulence within thunderstorms are greater at higher altitudes. Most cases of severe turbulence are encountered between 8,000 and 15,000 feet above the terrain. Usually the least turbulence is found in flying at or just below the base of the main thunderstorm cloud.

3. The heaviest turbulence is found to be closely associated with the areas of highest liquid water content of the storm. This makes it possible for airborne radar to pick out areas of maximum turbulence.

4. The probability of lightning strikes occuring is greatest near or slightly above the freezing level.

5. Quite obviously, to avoid these hazards you avoid flying into the center of active thunderstorms. Some of these phenomena, however, exist beyond the confines of the cell itself and the pilot electing to circumnavigate thunderstorm activity should keep them in mind.

6. Turbulence, while not usually as severe as in the cell itself, can exist in the clear air around the buildup, as can rain and hail. Lightning can also strike an aircraft in the clear in the vicinity of a thunderstorm.

DETOURING THUNDERSTORMS

1. Whenever it becomes necessary for a pilot on an Instrument Flight Rules flight plan to deviate from his approved route or altitude/flight level, a problem immediately presents itself to the air traffic controller. The affected area must be studied and an attempt made to accommodate the aircraft for the proposed route of flight. Revision to estimates must be made and adjacent or converging airways or areas must be considered.

2. Therefore, it is important that the request for deviation from route be forwarded to Air Traffic Control as far in advance as possible. Delay in submitting the request, or inability to do so, may delay or even preclude ATC approval of the request, or require that additional restrictions be placed on the clearance.

3. A pilot on an Instrument Flight Rules flight plan must not deviate from route without proper clearance as this may place him in conflict with other air traffic. Strict adherence to traffic clearance is necessary to assure an adequate level of safety. In those instances where thunderstorm conditions encountered are of such severity that an immediate deviation from course is determined to be necessary and time will not permit approval by ATC, the pilot's emergency authority may be exercised.

4. Insofar as possible, the following information should be furnished to ATC when requesting clearance to detour around thunderstorm activity:

a. Proposed point at which detour will commence.

b. Proposed route and extent of detour (direction and distance).

c. Altitude/s.

d. Point and estimated time where original route will be resumed.

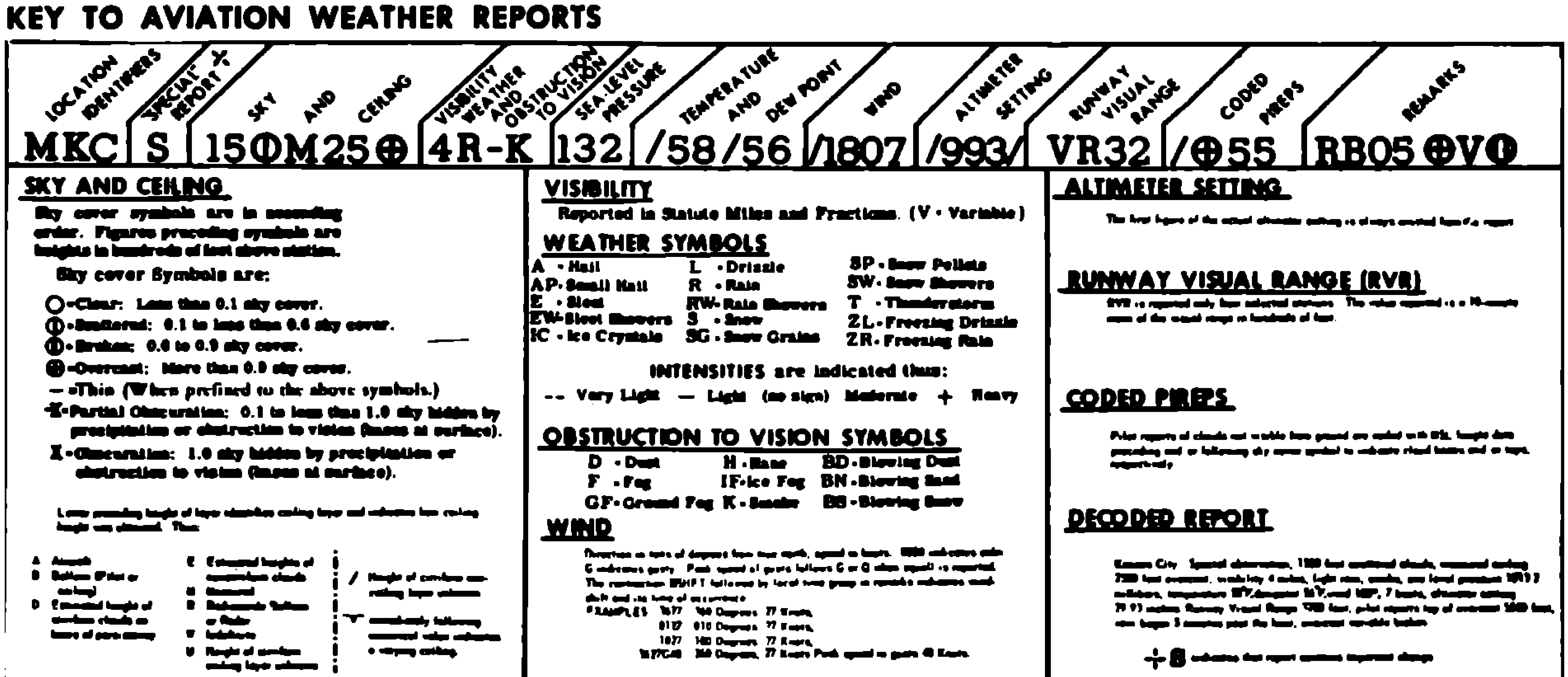
e. Flight conditions (IFR or VFR).

f. Any further deviation that may become necessary as the flight progresses.

g. Advise if the aircraft is equipped with functioning airborne radar.

5. When flying within the Continental Control Area, the proposed detour should be defined by appropriate navigational aids (however, not necessarily over or directly between such aids). When this is not possible and traffic exists at the desired altitude, ATC will be unable to approve the detour. In such cases, ATC may offer a clearance via the detour route at a different altitude. When an alternate altitude is not available, the pilot may elect to detour under his emergency authority.

KEY TO AVIATION WEATHER REPORTS



SAFETY OF FLIGHT

WAKE TURBULENCE

1. For years turbulence generated by aircraft was attributed to "prop wash." Pilots, in making maneuvers such as steep 360° and 720° turns, would occasionally get caught in their own "prop wash." The "prop wash" behind other aircraft caused some pretty rough rides, "go-arounds", some accidents and was the subject of a lot of "hangar flying". With the advent of the large jet transport and helicopters, the so-called "prop wash" problems enlarged to include "jet wash" and helicopter "down wash" turbulence. By this time, however, the problems associated with aircraft wake turbulence had been broken down into two categories—"thrust stream turbulence" and "wing tip vortices."

2. What was once throught to be prop wash was in fact vortex turbulence. "Prop/jet wash," i.e., thrust stream turbulence, can be a hazard to aircraft operating on the ground and pilots should take normal precautions to avoid taxiing close behind larger aircraft making an engine runup or running up when other smaller aircraft are close behind them, as the case may be. At distances of 400–500 feet "prop" or "jet wash" normally will not constitute a serious hazard to other aircraft operating on the ground. Also, it should not be a hazard to aircraft in flight except possibly in the case of a take-off or landing in the immediate area of an aircraft making a ground runup. An example of "jet wash" velocities is shown in Figure 1. These patterns will, of course, vary in shape and velocities with different aircraft and power settings, and will change when subjected to surface winds of differing relative directions and velocities.

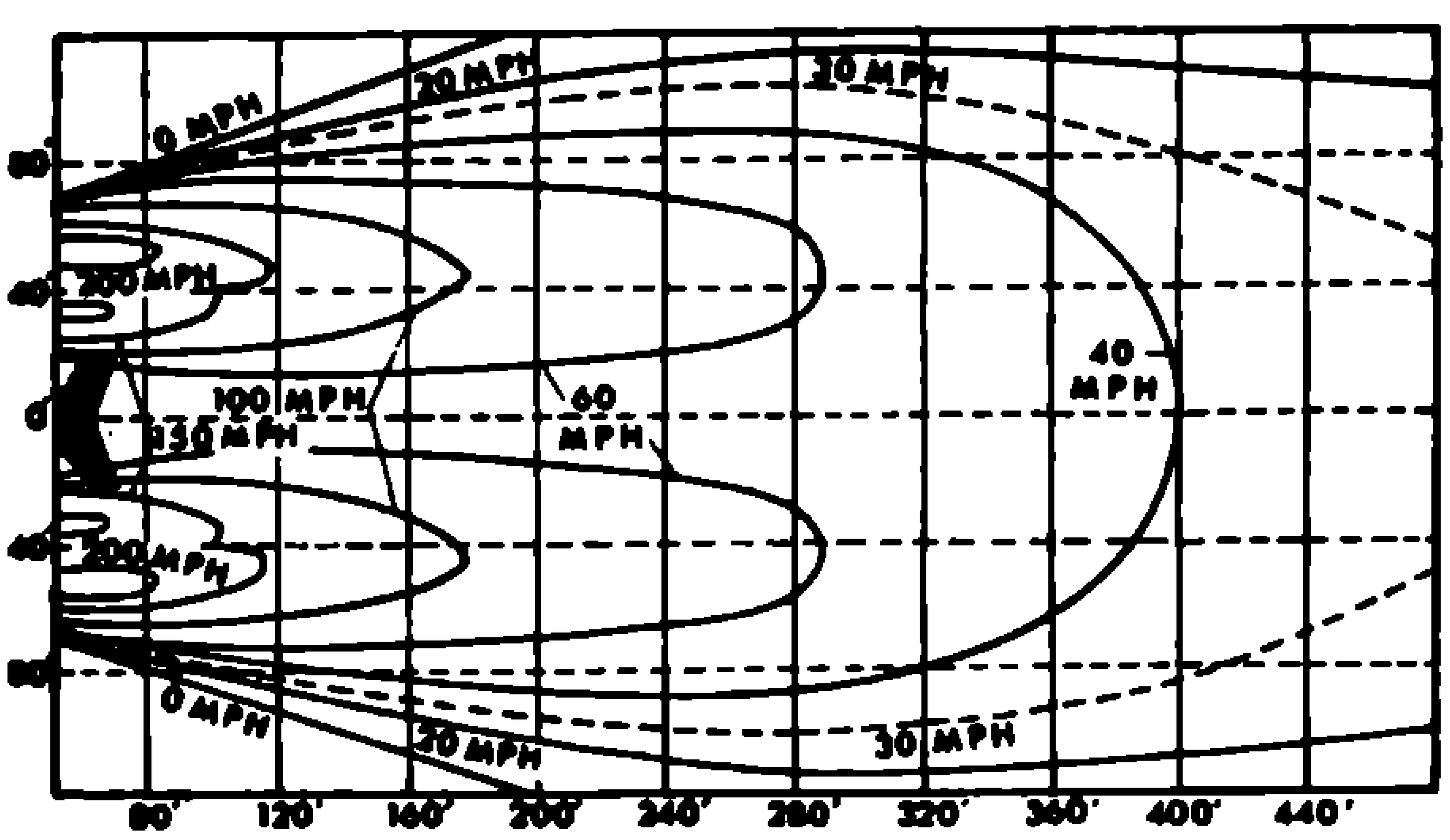


FIGURE 1.

Example thrust stream velocity curves of a typical large 4-engine turbojet aircraft in a no-wind condition at initial taxi power.

3. VORTICES

A vortex core is the center of a trailing mass of disturbed air created by the wing of an aircraft as it produces lift. An aircraft creates two such vortices with rotational air movement. As a lift-producing air foil passes through the air it leaves a continuous sheet of unstable air behind the trailing edge. Due to spillage about the wing tips, the air rolls into two distinct vortices, one trailing behind each wing tip. The roll up process is normally complete at a distance equal to about two to four times the wing or rotor span of the aircraft—about 200 to 600 feet behind the aircraft. If visible, formation of the vortex cores would appear approximately as shown in figure 2. Vortices generated by the rotors of a helicopter are shed and trail along the track behind the aircraft in the same manner as those generated by a fixed wing aircraft. These vortices have the same internal air circulation as those generated by fixed wing aircraft and have the same effect upon other aircraft.

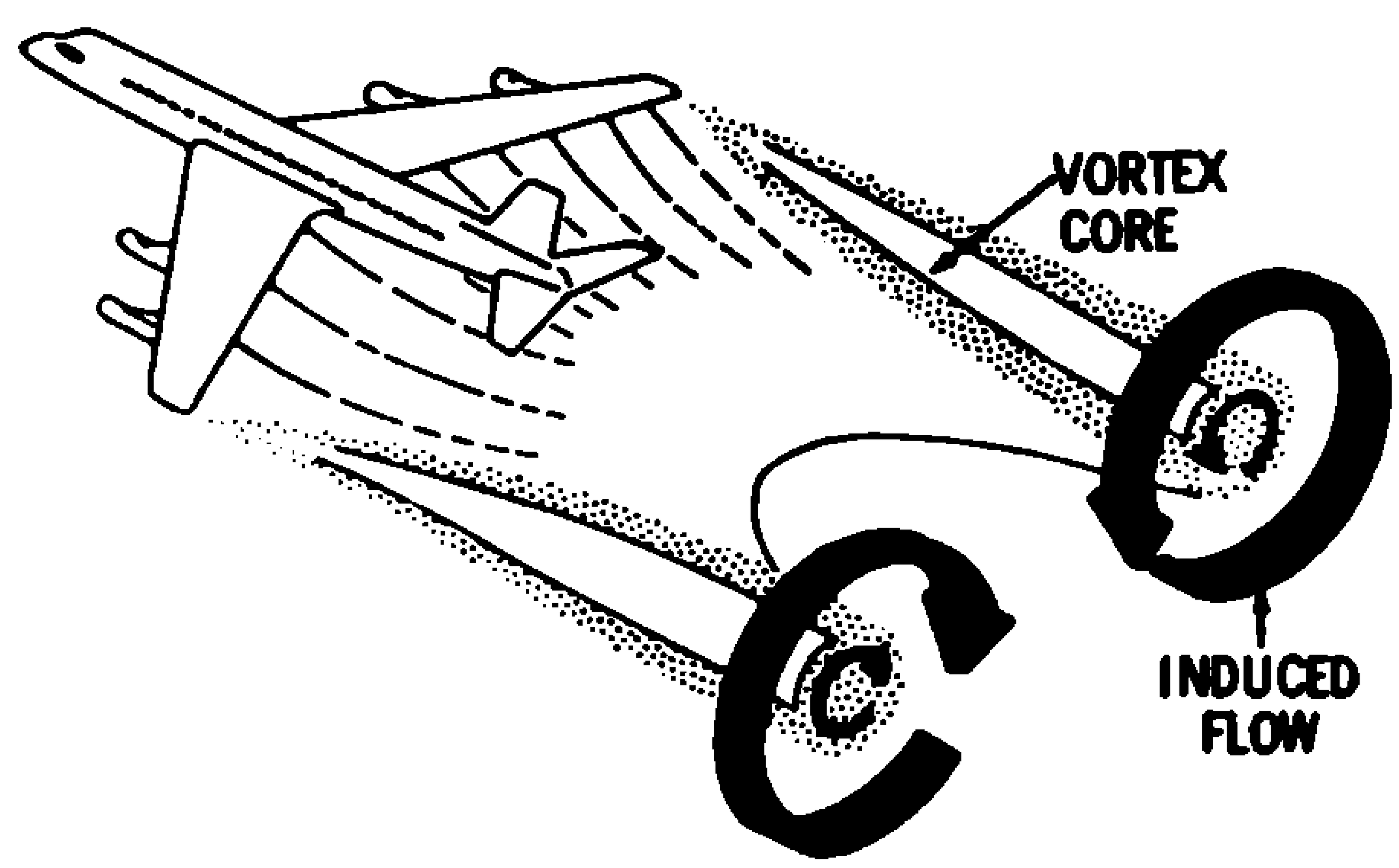


FIGURE 2

Example of wing tip vortices initial information. (Once formed, vortices extend and may be hazardous for an undetermined distance behind the generating aircraft.)

4. VORTEX INTENSITY

When an air foil passes through a mass of air and creates lift, energy proportional to the weight being lifted is transmitted to the mass of air. Generally, the greater the lift, the greater the energy transmitted to the air mass in the form of turbulence. The turbulence is directly related to the weight, wing span and speed of the aircraft. Its intensity is directly proportional to the weight and inversely proportional to the wing span and speed of the aircraft. The heavier and slower the aircraft, the greater the intensity of the air circulation in the vortex cores. Thus, it can be seen that modern large transport aircraft will create vortices having maximum rotational velocities during take-off and landing at or near maximum gross weights.

WAKE TURBULENCE (Con't)

5. VORTEX PERSISTENCY

There is no current practical knowledge that can be used as a yardstick to accurately measure the period of time vortices will be a hazard to other aircraft. Studies have been conducted and measurements made of the size of vortices and velocity of the air within them up to nearly three minutes after passage of large aircraft. Pilots have reported what they believed to be vortex turbulence five minutes and more after passage of another aircraft. No practical rule involving a time interval for one aircraft behind another will assure avoidance of the vortices generated by the first. However, other methods of avoiding the hazards associated with aircraft vortices are known and can be applied by pilots.

6. VORTEX DANGERS

"Why should I avoid flying in or through the vortex turbulence behind large aircraft?" is a question that a pilot might ask if accustomed only to the turbulence created by light single and twin engine aircraft. Perhaps the best answer, and the most impressive one is that the aerodynamic forces applied upon the light aircraft by the circulation of air in the vortices and the pilot's attempt to counteract it could result in the airframe design limits being exceeded and possibly structural failure. And then there is the pilot who has always been able to control his aircraft through any "prop wash" he has encountered. His excellent ability may mean nothing because the forces he encounters behind a heavily loaded large aircraft could exceed the control capability of his aircraft. A roll, descent, or combination of the two could continue even though full control travel or power is applied. The forces of the air in wing tip vortices can well exceed the aileron control capability or the climb rate of some aircraft. For those who want figures, the air in a vortex core can produce a roll rate of about 80 degrees per second which is about twice the roll rate capability of some light aircraft when using full aileron deflection. If the light aircraft stayed directly between the center of the vortex cores from a heavy jet transport it could encounter a downward flow of air of about 1,500 feet per minute. A light aircraft with a continued climb capability of 1,000 to 1,200 feet per minute could go only in one direction—*down*. Caught in such a position the pilot who altered his course could get caught by the roll forces or a combination of downward and roll forces. These forces have been sufficient to cause aircraft to do one or more complete rolls, to force them into the ground and in some instances a combination of the two actions.

7. VORTEX LOCATION

The best way of avoiding the vortices hazards is to know where they are most likely to be encountered and act accordingly. Since vortices are not formed until lift is produced they will not be generated by an aircraft taking off until just before lift off—at the point where rotation is made. Vortices cease to be generated by a landing aircraft when its wing ceases to provide lift—when it has actually landed. However, remember that a large aircraft could have taken off and be out of sight, or landed and be on the ramp and the vortices turbulence could still be present near the runway. Another factor to remember is the vertical and lateral movements of vortices. Figure 3 shows an example of both in a no-wind condition. Vortices generated more than 400 or 500 feet above the surface will drop nearly vertically in a no-wind condition until reaching a height equal to approximately one-half the wing span of the generating aircraft. At that point they start to curve outward and spread laterally away from the track of the aircraft. There is one other thing that must be remembered, that is—both the vertical and lateral move-

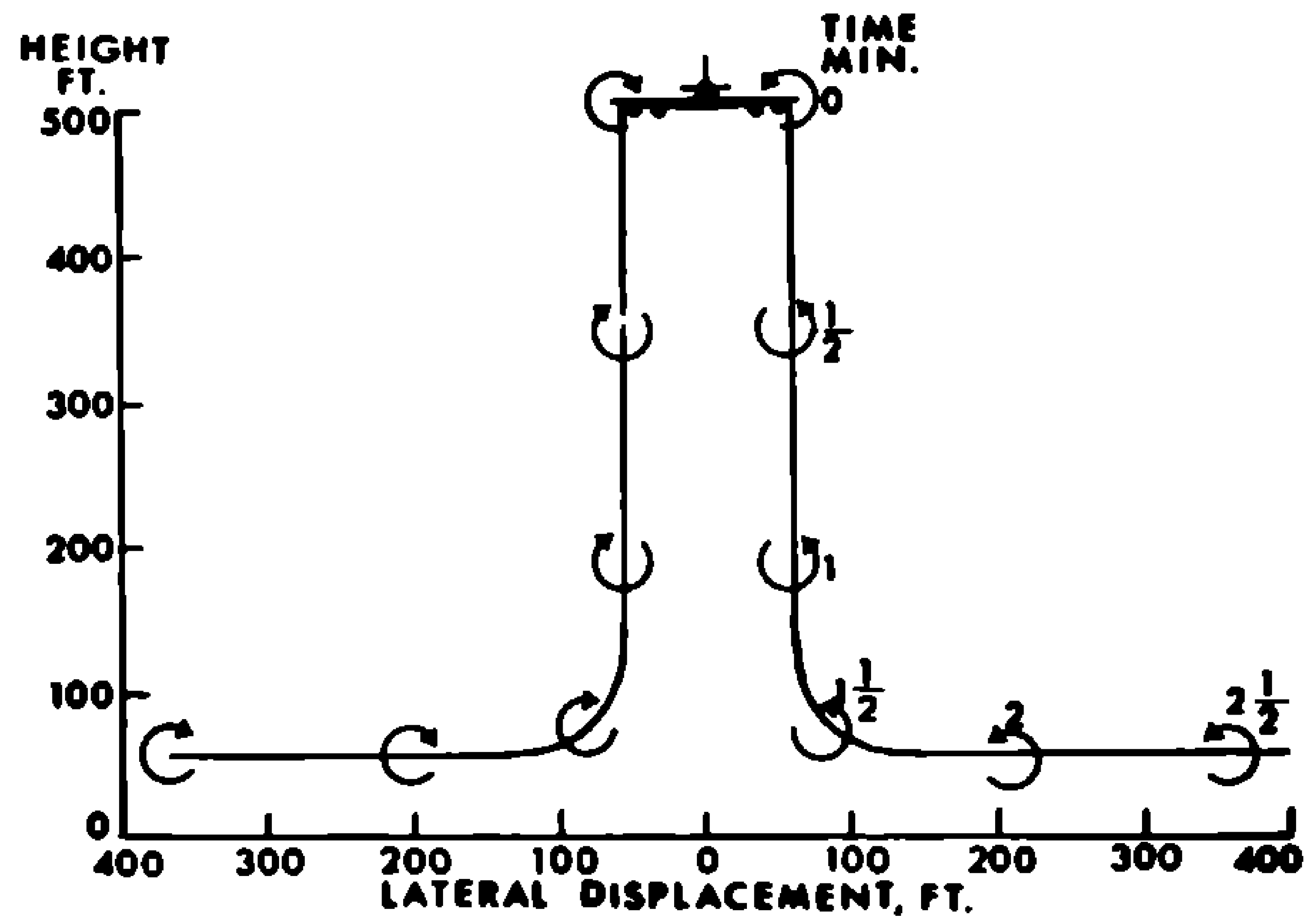


FIGURE 3

Example—Vertical and lateral displacement of vortex cores due to mutual and ground interactions. Based on a heavy transport aircraft at 167 k. in calm wind.

ment of the vortex cores, will be affected by and move with the encompassing air mass. A cross wind will displace the vortices from the vertical in their downward travel and affect the lateral rate of travel. A cross wind component of approximately four to six knots, depending upon the lateral rate of vortex travel, is sufficient to cause one core to remain laterally stationary over a line on the surface while the opposite core will travel at its own lateral rate plus that of the effective cross wind.

8. SUGGESTED PILOT ACTION

Unfortunately, the best advice is not always the most practical. In the case of vortex turbulence hazards avoidance, to insure 100% success would require pilots, particularly those flying relatively smaller aircraft, to refrain from operating in areas where the very large and heavy aircraft regularly operate. It would produce the desired result but would not be practical. What can you as a pilot do?

a. General Rule. When it is necessary to operate behind a large heavy aircraft try to remain above the flight path of that aircraft. Remember that vortices settle toward the surface and also that they are affected by the wind and move with that air mass down to within one hundred or so feet from the ground before spreading laterally away from each other and that the wind will continue to affect the vortex cores until dissipation occurs. Because of the infinite number of different circumstances that can exist, it is not practical to establish a set of inflexible rules. Therefore, we have outlined several possible courses of action and included their depiction in Figure 4, which, depending upon existing conditions and types of aircraft, pilots may wish to consider.

WAKE TURBULENCE (Con't)

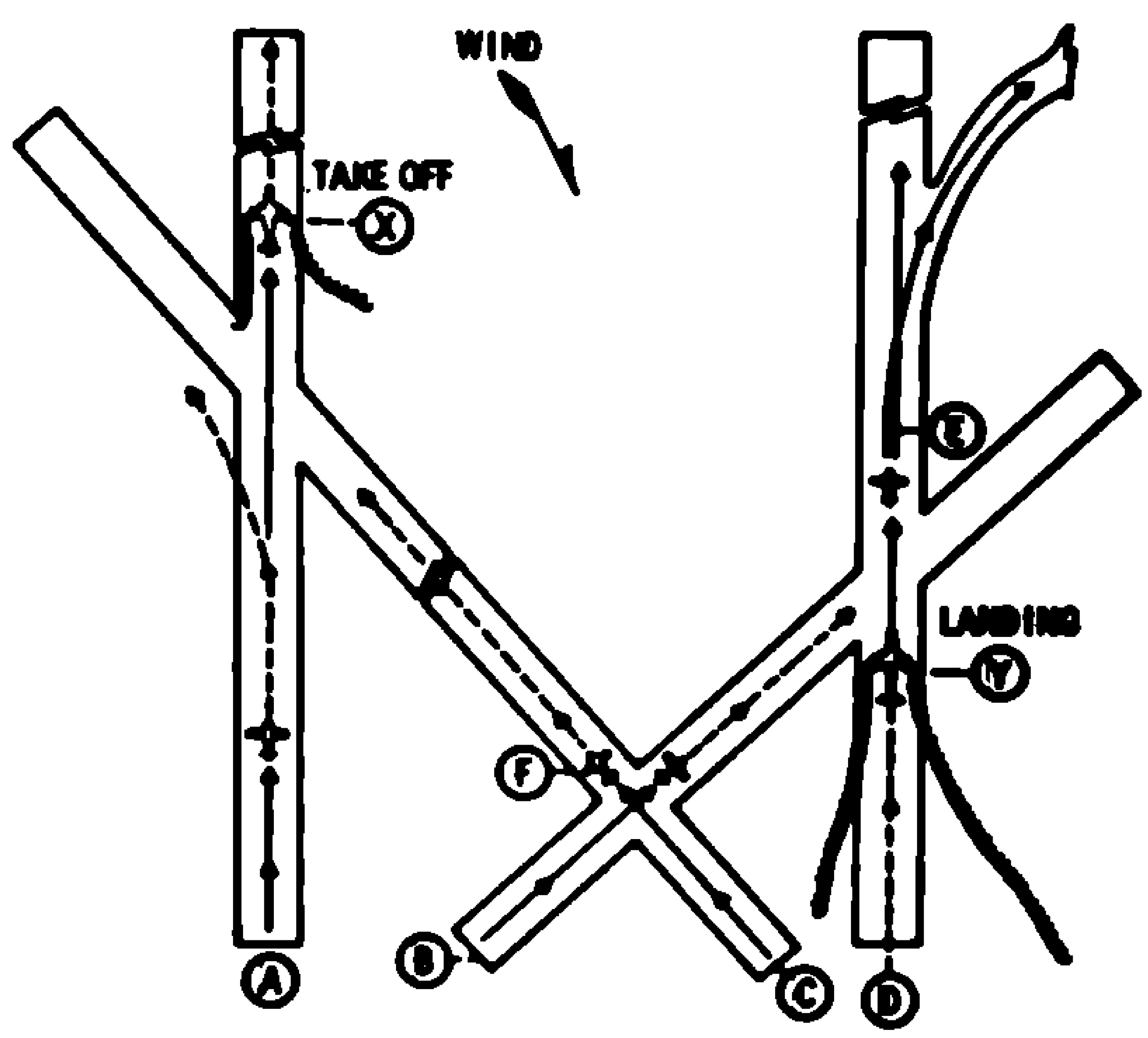


FIGURE 2. Example Take–off Landing Alternative courses of action.

Large Aircraft	*Small Aircraft* *Take-off**	*Landing**
TAKE-OFF at X	B, D, C, A	D, C, B, A
LAND at Y	A, C, E, B	A, B, E, F

*Take-off and landing points listed in order of probable preference with regard to turbulence from tafe-off and landing of large aircraft.

— → — →FLIGHT PATH
——→——→GROUND PATH

b. Take-off/Take-off.

(1) *Same or parallel runway.* Start the take-off roll at the end of the runway so that your take-off will be before the point where the previous aircraft's take-off was made. Make a normal performance take-off and climb and you should be behind and above the settling vortices of the preceding aircraft. If possible, make a turn away from the runway heading and if there is any cross wind make that turn into the wind. Don't depend upon the wind to dissipate the vortex core circulation appreciably unles it is 10–15 knots or higher and even then it could take several minutes. Also, remember that the lateral movement of vortices, even in a no wind condition, may place a vortex core over a parallel runway. With a light cross wind one vortex can remain stationary over the ground for some time, or even move upwind, before dissipating to any significant degree.

(2) *Intersecting runways.* If the large aircraft was still on the ground until well past the intersection and your take-off will permit climb to approximately 100 feet or more before you pass the intersection you should not encountered either the vortices or any appreciable thrust stream turbulence. Remember the general rule and make certain that you cross above the flight path of larger aircraft. Also remember that the larger aircraft will probably have a high gross weight at take-off and thus will generate vortices of maximum intensity. Also, consider the lateral movement of vortices and the possible effect the wind will have upon the movement.

c. Take-off/Landing.

(1) *Same or parallel runway.* When taking off after another aircraft has just landed, plan to become airborne beyond the point where the other aircraft landed. Remember, while starting take-off from an intersection may keep you out of the vortices of an aircraft that has just landed, it could place you in the vortices shed by one that took off several minutes before on the same or a parallel runway.

(2) *Intersection runways.* The precautions to heed when taking off after another aircraft has just landed on an intersecting runway are the same as those for a single or parallel runway. But don't forget the "heavy" that may have taken off from either your runway or the other one within the past several minutes.

d. Traffic Pattern. Don't fly below and behind a large aircraft in the traffic pattern. If practicable, plan your pattern to stay laterally separated from large aircraft by at least several hundred feet. When on the final approach, an above and behind position should keep you clear of the turbulence created by the preceding aircraft.

e. Landing/Landing. The same above and behind position on final approach will place the light aircraft pilot in a good position to touch down beyond the point where a preceding large aircraft landed, length of runway considered. If the runway has a visual approach slope indicator (VASI) system, a flight path in the "red and white" or with the top bar appearing a bit pink will keep you on or slightly above a normal glide slope. A complete description of the VASI system appears on page I–15.

f. Landing/Take-off. When landing after the take-off of a large aircraft, make a normal landing near the approach end of the runway and be solidly on the ground before reaching the point where the large aircraft took off. Although vortices from the departing aircraft will not be formed until the point of rotation, remember that the wind can cause the turbulence to move down the runway toward you.

9. AIR TRAFFIC PROCEDURES. When the tower controller advises you "CAUTION WAKE TURBULENCE," etc., he is following his procedures and warning you that it may exist because of an arcraft that recently made a take-off or landing. When you receive such an advisory, don't hesitate to request further information if you believe it will assist you in analyzing the situation and determining the course of action you wish to take. Remember, even though a clearance for take-off or landing has been issued, if you believe it safer to wait, use a different runway, or in some other way alter your intended operation, ask the controller for a revised clearance Sometimes, air traffic clearances include use of the word "IMMEDIATE." For example, "CLEARED FOR IMMEDIATE TAKE-OFF." In such cases, the word is used for purposes of air traffic separation. The clearance may be refused if you believe another course of action would be better suited to your intended operation. The controller's primary job is to aid in the

WAKE TURBULENCE *(Con't)*

prevention of collision between aircraft. However, he will assist you in any way he can while accomplishing his job.

NEAR MIDAIR COLLISION REPORTING

1. The agency is vitally interested in all near midair collision incidents. Each reported incident is thoroughly investigated by the Agency as soon as received in accordance with the established procedures. In order to ensure expeditious handling, all airmen are urged to report each incident immediately to.

a. Nearest FAA Air Traffic Control facility or Flight Service Station by radio.

b. Telephone report at next point of landing to nearest FAA Air Traffic Control facility or Flight Service Station.

c. Written in lieu of *a* and *b* above the nearest Air Carrier District Office or General Aviation District Office.

2. The following information should be reported if available:

a. Date and time (GMT) of incident.

b. Location of incident and altitude.

c. Identification and type of reporting aircraft; aircrew destination; name and home base of pilot.

d. Identification and type of other aircraft; aircrew destination; name and home base of pilot.

e. Type of flight plans; station altimeter setting used.

f. Detailed weather conditions at flight altitude/level.

g. Approximate courses of both aircraft; indicate if one or both aircraft were climbing/descending.

h. Reported separation in distance at first sighting; proximity at closest point horizontally and vertically; length of time in sight prior to evasive action.

i. Degree of evasive action taken, if any (from both aircraft, if possible); injuries, if any.

3. Any inquiry pertaining to the incident should be made to the FAA General Aviation District Office wherein the incident occurred.

MEDICAL FACTS FOR PILOTS

GENERAL

Just as your aircraft is required to undergo regular checks and maintenance, you are also required to undergo regular medical examinations to ensure your fitness to fly. The physical standards you are required to meet are minimum standards. You do not have to be a superman to fly. Many defects can be compensated for, as, for example, wearing glasses for visual defects. You may be required to demonstrate by a medical flight test that you can compensate for any other defects of potential significance to flight safety.

Student pilots should visit a Designated Aviation Medical Examiner and determine if they meet the standards before spending much money taking flying instructions.

It should be recalled that humans are essentially earthbound creatures. However if we are aware of certain aeromedical factors, and pay attention to these, we can leave the earth and fly safely. What follows will not be one hard comprehensive lesson in aviation medicine. It will point out the more important factors with which you should be familiar prior to flying.

Modern industry's record in providing reliable equipment is very good. When the pilot enters the aircraft, he becomes an integral part of the man-machine system. He is just as essential to a successful flight as the control surfaces. To ignore the pilot in preflight planning would be as senseless as failing to inspect the integrity of the control surfaces or any other vital part of the machine. The pilot himself has the sole responsibility for determining his reliability prior to entering the cockpit for flight.

While piloting an aircraft, an individual should be free of conditions which are harmful to alertness, ability to make correct decisions, and rapid reaction times. Persons with conditions which are apt to produce sudden incapacitation, such as epilepsy, serious heart trouble, uncontrolled diabetes mellitus or diabetes mellitus requiring hypoglycemis agents, and certain other conditions hazardous to flight, cannot be medically certified according to the Federal Aviation Regulations. Conditions such as acute infections, anemias, and peptic ulcers, are temporary disqualifying. Consult your Aviation Medical Examiner when in doubt about any aspect of your health status, just as you would consult a licensed aviation mechanic when in doubt about the engine status. Specific aeromedical factors are herein explained. For additional information on these or other aeromedical flight factors, write to: The Federal Air Surgeon, Federal Aviation Agency, Washington, D.C. 20553.

FATIGUE

Fatigue generally slows reaction times and causes foolish errors due to inattention. In addition to the most common cause of fatigue, insufficient rest and loss of sleep, the pressures of business, financial worries and family problems, can be important contributing factors. If your fatigue is marked prior to a given flight, don't fly. To prevent fatigue effects during long flights, keep active with respect to making ground checks, radio-navigation position plotting, and remaining mentally active.

HYPOXIA

Hypoxia in simple terms is a lack of sufficient oxygen to keep the brain and other body tissues functioning properly. Wide individual variation occurs with respect to susceptibility to hypoxia. In addition to progressively insufficient oxygen at higher altitudes, anything interfering with the blood's ability to carry oxygen can contribute to hypoxia (anemias, carbon monoxide, and certain drugs). Also, alcohol and various drugs decrease the brain's tolerance to hypoxia.

Your body has no built in alarm system to let you know when you are not getting enough oxygen. It is impossible to predict when or where hypoxia will occur during a given flight, or how it will manifest itself.

A major early sympton of hypoxia is an increased sense of well-being (referred to as euphoria). This progresses to slow reactions, impaired thinking ability, unusual fatigue, and dull headache feeling.

The symptoms are slow but progressive, insidious in onset, and are most marked at altitudes starting above ten thousand feet. Night vision, however, can be impaired starting at altitudes lower than ten thousand feet. Heavy smokers may also experience early symptoms of hypoxia at altitudes lower than is so with non-smokers.

If you observe the general rule of not flying above ten thousand feet without supplemental oxygen, you will not get into trouble.

ALCOHOL

Do not fly while under the influence of alcohol. An excellent rule is to allow twenty-four hours between the last drink and takeoff time. Even small amounts of alcohol in the system can adversely affect judgement and decision-making abilities.

Remember that your body metabolizes alcohol at a fixed rate, and no amount of coffee or medication will alter this rate.

By all means, do not fly with a hangover, or a "masked hangover" (symptoms suppressed by aspirin or other medication).

DRUGS

Self-medication or taking medicine in any form when you are flying can be extremely hazardous. Even simple home or over-the-counter remedies and drugs such as

DRUGS (Con't)

aspirin, antihistamines, cold tablets, cough mixtures, laxatives, tranquilizers and appetite suppressors, may seriously impair the judgment and coordination needed while flying. The safest rule is to take no medicine while flying, except on the advice of your Aviation Medical Examiner. It should also be remembered that the condition for which the drug is required, may of itself be very hazardous to flying, even when the symptoms are suppressed by the drug.

Certain specific drugs which have been associated with aircraft accidents in the recent past are: *Antihistamines* (widely prescribed for hay fever and other allergies); *Tranquillizers* (prescribed for nervous conditions, hypertension, and other conditions); *Reducing Drugs* (amphetamines and other appetite suppressing drugs can produce sensations of well-being which have an adverse effect on judgement); *Barbiturates, Nerve tonics or pills* (prescribed for digestive and other disorders, barbiturates produce a marked suppression on mental alertness).

VERTIGO

The word itself is hard to define. To earthbound individuals it usually means dizziness or swimming of the head. To a pilot it means, in simple terms, that he doesn't know which end is up. In fact, vertigo during flight can have very fatal consequences.

On the ground we know which way is up to the combined use of three senses:

1. **Vision**—We can *see* where we are in relation to fixed objects.
2. **Pressure**—Gravitational pull on muscles and joints tells us which way is down.
3. **Special Parts in Our Inner Ear**—The otoliths tells us which way is down by gravitational pull. It should be noted that accelerations of the body are detected by the fluid in the semi-circular canals of the inner ear, and this tells us when we change position. However, in the absence of a visual reference, such as flying into a cloud or overcast, the accelerations can be confusing, especially since their forces can be misinterpreted as gravitational pulls on the muscles and otoliths. The result is often disorientation and vertigo (or dizziness).

All pilots should have an instructor pilot produce maneuvers which will produce the sensation of vertigo. Once experienced, later unanticipated incidents of vertigo can be overcome. Closing the eyes for a second or two may help, as will watching the flight instruments, believing them, and controlling the airplane in accordance with the information presented on the instruments. All pilots should obtain the minimum training recommended by the FAA for altitude control of aircraft solely by reference to the gyroscopic instruments.

Pilots are susceptible to experiencing vertigo at night, and in any flight condition when outside visibility is reduced to the point that the horizon is obscured. An additional type of vertigo is known as *flicker vertigo*. Light, flickering at certain frequencies, from four to twenty times per second, can produce unpleasant and dangerous reactions in some persons. These reactions may include nausea, dizziness, unconsciouness, or even reactions similar to epileptic fit. In a single engine propeller airplane, heading into the sun, the propeller may cut the sun to give this flashing effect, particularly during landings when the engine is throttled back. These undesirable effects may be avoided by not staring directly through the prop for more than a moment, and by making frequent but small changes in RPM. The flickering light traversing helicopter blades has been known to cause this difficulty, as has the bounce-back from rotating beacons on aircraft which have penetrated clouds.

CARBON MONOXIDE

Carbon monoxide is a colorless, odorless, tasteless product of an internal combustion engine and is always present in exhaust fumes. Even minute quantities of carbon monoxide breathed over a long period of time, may lead to dire consequences.

For biochemical reasons, carbon monoxide has a greater ability to combine with the hemoglobin of the blood than oxygen. Furthermore, once carbon monoxide is absorbed in the blood, it sticks "like glue" to the hemoglobin and actually prevents the oxygen from attaching to the hemoglobin.

Most heaters in light aircraft work by air flowing over the manifold. So if you have to use the heater, be wary if you smell exhaust fumes. The onset of symptoms is insidious, with "blurred thinking", a possible feeling of uneasiness, and subsequent dizziness. Later headache occurs. Immediately shut off the heater, open the air ventilators, descend to lower altitudes, and land at the nearest airfield. Consult an Aviation Medical Examiner. It may take several days to fully recover and clear the body of the carbon monoxide.

VISION

On the ground, reduced or impaired vision can sometimes be dangerous depending on where you are and what you are doing. In flying it is always dangerous.

On the ground or in the air, a number of factors such as hypoxia, carbon monoxide, alcohol, drugs, fatigue, or even bright sunlight can affect your vision. In the air these effects are critical.

Some good specific rules are: make use of sunglasses on bright days to avoid eye fatigue; during night flights use red covers on the flashlights to avoid destroying any dark adaption; remember that drugs, alcohol, heavy smoking and the other factors mentioned above, have early effects on visual acuity.

MIDDLE EAR DISCOMFORT OR PAIN

Certain persons (whether pilots or passengers) have difficulty balancing the air loads on the ear drum while descending. This is particularly troublesome if a head cold or throat inflammation keeps the eustacian tube from opening properly. If this trouble occurs during descent, try swallowing, yawning, or holding the nose and mouth shut and forcibly exhaling. If no relief occurs, climb back up a few thousand feet to relieve the presure on the outer drum. Then descend again, using thse measures. A more gradual descent may be tried, and it may be necessary to go through several climbs and descents to "stair step" down. If a nasal inhaler is available, it may afford relief. If trouble persists several hours after landing, consult your Aviation Medical Examiner .

NOTE.—*If you find yourself airborne with a head cold, you may possibly avoid trouble by using an inhaler kept as part of the flight kit.*

PANIC

The development of panic in inexperienced pilots is a process which can get into a vicious circle with itself and lead to unwise and precipitous action. If lost, or in some other predicament, forcibly take stock of yourself, and do not allow panic to mushroom. Panic can be controlled. Remember, *Prevent Panic to Think Straight*. Fear is a normal protective reaction, and occurs in normal individuals. Fear progression to panic is an abnormal development.

SCUBA DIVING

You may use your plane to fly to a sea resort or lake for a day's SCUBA diving, and then fly home, all within a few hours' time. This can be dangerous, particularly if you have been diving to depths for any length of time.

Under the increased pressure of the water, excess nitrogen is absorbed into your system. If sufficient time has not elapsed prior to takeoff for your system to rid itself of this excess gas, you may experience the bends at altitude under 10,000 feet where most light planes fly.

BIRD HAZARDS

Migratory Patterns

The birds considered of greatest potential hazard to aircraft because of large size, abundance, or habit of flying in dense flocks are the whistling swans, Canada geese, snow geese, blue geese, white-fronted geese, mallards, pintails, gulls, vultures, starlings, and blackbirds. Birds of these species are considered particularly hazardous during spring and fall migration and when they are concentrated in wintering areas. At some airports, large flocks of sandpipers, horned larks, tree swallows, longspurs, white pelicans, sandhill cranes, or other species could be a problem at certain seasons.

Unfortunately, we do not have complete data for the United States concerning the migration paths of all of these species, or the exact times of migration, or the altitudes at which these birds fly, or the effects of weather on migration patterns. However, available data are summarized below for birds of six of these species—whistling swans, Canada geese, snow geese, mallards, pintails, and double-crested cormorants.

Since migrating waterfowl tend to dive when closely approached by aircraft, pilots are warned not to fly directly under migrating flocks of swans, geese or ducks.

WHISTLING SWANS

Whistling swans are our largest common migratory waterfowl, and during the migration seasons concentrate in a narrow and fairly well-defined path passing close to the airports of Duluth, Milwaukee, Detroit, Toledo, Cleveland, Buffalo, Pittsburgh, Harrisburg, Baltimore, and Washington, D. C.

Migration—In the spring, swans migrate over Chesapeake Bay, the lower Susquehanna River, then overland to Lake Erie, through Michigan, Wisconsin, North Dakota, Manitoba, and Saskatchewan to the Canadian Arctic.

Some birds wintering on Great Salt Lake migrate northwest to the Pacific coast, then up the coast to Alaska; others migrate northeast through Montana, Alberta, and Saskatchewan to the breeding grounds.

Some Pacific coast swans migrate north along the coast, and others migrate through the interior, crossing over Washington, Alberta, and Saskatchewan to reach the breeding grounds. The fall flights are made over approximately the same routes.

Spring Migration Dates

		Peak
ATLANTIC COAST		
Chesapeake Bay to Lake Erie	Mar. 20–Mar. 31	Mar. 10–April 25
Michigan	Mar. 18–April 11	Mar. 17–April 24
Wisconsin	Mar. 26–April 11	Mar. 24–April 15
Minnesota		April 2–April 26
North Dakota and northeastern South Dakota	April 10–April 20	
WEST COAST		
Utah (Great Salt Lake)		Leave in late March
Oregon	Mar. 18–Mar. 28	Feb. 1–April 9
California (northern)		Mar. 4–Mar. 25
California (Sacramento Val.)		Jan. 24–Feb. 21

Fall Migration Dates

		Peak
ATLANTIC COAST		
So. Saskatchewan	Sept. 9–Nov. 1	Oct. 15
So. Manitoba	Oct. 7–Nov. 16	
Minnesota, Wisconsin, and Michigan	Oct. 16–Nov. 23	
No. Ohio, Lake Erie, and Ontario	Oct. 18–Nov. 28	
Pennsylvania and Maryland	Oct. 20–Nov. 28	Oct. 25–Nov. 20
North Carolina	Oct. 21–	
WEST COAST		
Utah (Gr. Salt Lake)	Oct. 20–Nov. 15	(first arrivals)
Oregon	Oct. 1–Dec. 5	Oct. 15–Nov. 20
Nevada	Oct. 28–Nov. 20	
California (northern)	Nov. 8–Dec. 8	
California (Sacramento Val.)	Oct. 30–Nov. 26	

Flight—Swans are good fliers and make nonstop flights of several hundred miles (Chesapeake Bay to Lake Erie), sometimes at considerable altitude (up to approximately 6,000 feet).

CANADA GEESE

Geese are considered the greatest hazard to aircraft because of their abundance, large size, occurrence in large flocks, relatively slow flight and high altitude of flight. Of the 400,000 to 500,000 Canada geese that migrate between Hudson and James Bays and the Mississippi Valley, over 100,000 pass through Horicon Marsh in Wisconsin. In migrating between Horicon Marsh and southern Illinois, the bulk of these geese pass about 25 miles west of Milwaukee's Municipal Field and 50 miles west of O'Hare Field, Chicago. At times stray flocks pass over or very close to these airports. The thousands of Canada geese migrating to and from Jack Miner's sanctuary at Kingsville, Ontario, pass only 10 to 20 miles

CANADA GEESE—*Continued*

east of Detroit; and in the fall many of these birds pass close to the municipal airport at Toledo.

Migration—Canada geese migrate over several broad fronts. Atlantic coast birds breed mostly east of James and Hudson Bays; they migrate up Chesapeake Bay, cross to Lake Erie, and then fly north. Another flight goes up the Mississippi River and over the Great Lakes to the breeding ground west of Hudson Bay. Birds wintering on Great Salt Lake disperse to breed in the Northwestern States and the southern parts of the western Canadian Provinces. West coast geese migrate mostly north along the coast to their breeding grounds in Alaska. The fall flights are over the same routes.

Spring Migration Dates

		Peak
ATLANTIC COAST		
Maryland	Mar. 10–April 14	
Pennsylvania and New Jersey	Mar. 17–May 10	
New York (western)	Mar. 12–May 5	Mar. 26–April 20
Ontario (southern)	Mar. 27–May 5	April 1–May 5
Quebec	April 9–May 13	April 15–May 12
Nova Scotia	Feb. 21–April 27	Mar. 16–April 2
INTERIOR		
Louisiana	Feb. 15–Mar. 14	
Oklahoma	Feb. 17–Mar. 29	
Kansas, Nebraska	Feb. 16–April 7	
Illinois	Jan. 11–April 1	
Michigan	Mar. 21–April 22	
Wisconsin, Minnesota	Mar. 5–May 10	
No. and So. Dakota	Mar. 1–May 19	
So. Manitoba and Saskatchewan	April 8–May 15	
Ontario (James Bay)	April 23	
WEST COAST		
California	Feb. 25–April 10	
Oregon	Feb. 1–May 1	
Washington	Mar. 6–Apr. 23	

Fall Migration Dates

		Peak
ATLANTIC COAST		
Ontario and Quebec	Sept. 30–Oct. 28	
Vermont	Oct. 8–Nov. 23	
New York	Oct. 7–Nov. 20	
Pennsylvania	Sept. 30–Nov. 6	
New Jersey	Oct. 12–Oct. 25	
Maryland	Oct. 1–Nov. 20	Oct. 15–Nov. 5
Virginia	Oct. 8–winters	
INTERIOR		
Manitoba	Oct. 3–Oct. 15	
Montana	Oct. 2–Oct. 28	
No. and So. Dakota	Sept. 30–Nov. 26	
Minnesota, Wisconsin, and Michigan	Sept. 22–Nov. 20	
Illinois and Indiana	Sept. 22–Dec. 8	
Kansas	Oct. 16–winters	
Missouri, Arkansas	Oct. 2–Nov. 29	
Louisiana, Texas	Sept. 23–Oct. 28	
WEST COAST		
California	Sept. 1–Nov. 10	Oct. 21
Oregon	Sept. 1–Sept. 12	Sept. 1–3
Washington	Sept. 6–Nov. 11	

Flight—Canada geese can fly several hundred miles nonstop. The vast majority of geese appear to migrate at altitudes between 3,000 and 8,000 feet; some have been observed at 15,000 feet.

SNOW GEESE

Snow geese and blue geese in numbers totaling 400,000 to 500,000 move down the Mississippi Valley on such a broad front in the fall that they are likely to pass over or near most of the airports in the Valley. They concentrate at several places along the Illinois, Mississippi, and Missouri Rivers, but seldom in numbers over 25,000. When they leave their gulf coast wintering grounds in March, the bulk of the population moves en masse to northwest Missouri and southwest Iowa. From there, they gradually move up the Missouri River Valley to Sand Lake and Putney Slough, South Dakota. The movement of several hundred thousand blue and snow geese to the Missouri River Valley north of St. Joseph, Missouri, and their gradual movement up this valley creates conditions hazardous to aircraft in the vicinity of airports at Kansas City, Omaha, Sioux City, and Sioux Falls.

Migration—Lesser snow geese migrate over a broad front through the Mississippi River Valley, with the center of the spring flight passing over Louisiana, Arkansas, Missouri, Iowa, Minnesota, South Dakota, and North Dakota. The fall flight spreads farther east, reaching into Michigan, Ohio, and Indiana. Birds that winter in the Central Valley of California migrate through Tule Lake in northern California, Malheur Lake in Oregon, and along the coast of British Columbia. There also may be an overland flight between Malheur Lake and the Canadian Arctic.

Greater snow geese migrate almost nonstop from wintering grounds to breeding grounds. They migrate northward along the Atlantic coast of the United States and then inland (up the Hudson and Connecticut Rivers) to a stopover area on the St. Lawrence, at Cap Tourmente, Quebec. From there, the line of flight presumably is overland through Ungava to the breeding grounds.– The fall flight is over the same route.

Spring Migration Dates

		Peak
ATLANTIC COAST (Greater Snow Geese)		
North Carolina	last–Mar. 1	
Delaware Bay	Feb. ~~25–April~~ 6	Mar. 26–Mar. 29
St. Lawrence River, Quebec	Mar. 11–May 27	Mar. 25–April 29
Baffin Island (65°N)	first–May 29	
INTERIOR (Lesser Snow Geese)		
Texas and Louisiana	Mar. 1–Mar. 20	Mar. 15
Oklahoma and Arkansas	Feb. 28–April 1	
Kansas and Missouri	Feb. 24–April 13	Mar. 10–April 13
Nebraska and Iowa	Feb. 26–April 19	Mar. 20–April 2
North and South Dakota, Minnesota and Wisconsin	Mar. 2–May 10	Mar. 10–May 4
Southern Manitoba	Mar. 27–May 17	April 18–May 13
Ontario (James Bay)	April 25–June 8	
WEST COAST (Lesser Snow Geese)		
Nevada	Feb. 1–Mar. 10	Mar. 10
California (Sacramento)	Feb. 1–Mar. 27	Feb. 20–Mar. 27
California (northern)	Feb. 19–April 15	Mar. 4–Mar. 29
Oregon	Mar. 0–April 22	Mar. 25–April 15
Washington	April 3–May 9	
British Columbia	April 10–May 22	
Alaska	April 16–May 31	April 10

SNOW GEESE—*Continued*

Fall Migration Dates

		Peak
ATLANTIC COAST		
(Greater Snow Geese)		
Baffin Island	last-Sept 15	
St. Lawrence River, Quebec	Sept 1–Oct. 21	
New York	Oct. 8–Nov. 21	
Brigantine, New Jersey	Oct. 8–Dec. 10	
Delaware Bay, Chincoteague Bay, Back Bay, Virginia, and North Carolina	Oct. 14–winters	Nov. 1–Dec. 30
INTERIOR		
(Lesser Snow Geese)		
Franklin (Coats Island	large flocks leaving Sept. 3	
Ontario (James Bay)	Sept. 15–Nov. 10	Oct. 3–Oct. 30
Southern Manitoba	Oct. 5–Oct. 31	
North Dakota and Minnesota	Oct. 5–Nov. 15	
Wisconsin and Michigan	Oct. 5–Nov. 16	
Iowa, Illinois, and Missouri	Oct. 5–Nov. 21	Nov. 1
Louisana	Oct. 5–winters	Oct. 10–Dec. 1
Texas	Oct. 13–winters	Oct. 20–Dec. 1
WEST COAST		
(Lesser Snow Geese)		
Alaska	Sept. 4–Sept. 15	
British Columbia	Sept. 28–Oct. 30	Oct. 22–Oct. 30
Washington	Sept. 28–Nov. 22	
Oregon	Sept. 28–Nov. 22	Oct. 9–Oct. 30
California	Oct. 4–winters	Oct. 4–Nov. 1
Alberta	Sept. 29–Nov. 1	Oct. 9
Montana	Oct. 10–Nov. 24	
Idaho	Oct. 27–Nov. 25	
Utah	Sept. 25–Dec. 20	Oct. 9–Oct. 15
Nevada	Sept. 20–Oct. 18	Oct. 10–Oct. 16

Flight—Lesser snow geese are good fliers, capable of making long distance, nonstop flights. Many stopover locations are used. An altitude of 3,000 feet has been estimated. Greater snow geese have been reported between 800 and 1,500 feet, and probably go much higher.

MALLARDS AND PINTAILS

Mallards and Pintails are included partly because they are the commonest North American ducks, but more specifically because they concentrate in very large numbers in the Mississippi Valley and in the Central Valley of California. Each migration season about 7 million to 15 million ducks pass through the Mississippi Valley; 3 million to 6 million use the Central Valley of California; and 2 million to 3 million migrate through the Atlantic Coastal States.

More ducks pass in the vicinity of Lambert Field, St. Louis, than any other major air terminal east of the Rocky Mountains, no doubt because of the channeling effect of the Illinois and Mississippi Rivers. The number of ducks migrating over St. Louis is several times greater than at Kansas City, Des Moines, or Minneapolis. However, even these airports have such large numbers of ducks passing in their vicinity as to create hazardous conditions for departing and incoming aircraft. Airports at Sioux Falls, Sioux City, Omaha, Moline, Memphis, and New Orleans are about equally subject to the possibility of strikes by ducks as at Kansas City, Des Moines, and Minneapolis.

Airports at Detriot, Toledo, and Cleveland occur in a third level of potential danger from duck strikes. A somewhat smaller passage of ducks, largely lesser scaup canvas back and redheads, extends in an east-southeast direction from central Minnesota to the Chesapeake Bay area. En route these ducks concentrate in especially large numbers at Lake St. Clair and the Detroit River.

Migration—Mallards migrate over a broad front, covering most of the Western States. The heaviest concentrations are through the Mississippi and Missouri River Valleys. There is also a flight along the west coast.

Spring Migration Dates

INTERIOR	
Kansas	Feb. 24–Mar. 25
Nebraska	Mar. 2–Mar. 27
Iowa	Mar. 16–April 10
Illinois and Indiana	Mar. 1–April 2
Michigan	Mar. 14–May 6
Wisconsin and Minnesota	Mar. 16–April 28
North and South Dakota	Mar. 28–April 20
Saskatchewan	April 14–May 5
WEST COAST	
Washington	Feb. 28–Mar. 31

Fall Migration Dates

		Peak
INTERIOR		
Alberta	Sept. 28–Oct. 14	
Saskatchewan and Manitoba	Sept. 19–Nov. 9	
Montana	Aug. 30–Nov. 2	
North Dakota	Aug. 9–Nov. 15	Sept. 11–Oct. 18
Minnesota and Wisconsin	Sept. 5–Nov. 24	about Oct. 15
South Dakota and Nebraska	Sept. 11–Nov. 9	
Iowa, Illinois, Kansas, and Missouri	Oct. 4–Nov. 20	about Nov. 11
Arkansas	Oct. 24–winters	
WEST COAST		
Washington	Sept. 6–Nov. 28	

Migration—Pintails migrate over a broad front, covering most of the Western States. The main flights are through the interior and the Pacific States. In the fall there are more pintails in the Pacific States than in the interior of the continent, but in the spring the heaviest flight is through the Great Plains. In the spring and fall in the East, there are flights between Chesapeake Bay and the Great Lakes, and also along the Atlantic coast and the St. Lawrence River.

Spring Migration Dates

		Peak
ATLANTIC COAST		
Maryland	Feb. 15–Mar. 20	Mar. 5
Pennsylvania	Mar. 3–April 1	
New York	Mar. 5–April 26	April 26
Vermont	April 13–April 30	

PINTAILS—*Continued*

Spring Migration Dates

		Peak
INTERIOR		
Texas	Jan. 9–Mar. 25	Jan. 12–Mar. 9
Louisiana and Arkansas	Jan 27–Mar. 20	
Kansas, Missouri, and Kentucky	Feb. 10–May 3	Feb. 28–Mar. 26
Nebraska and Iowa	Feb. 26–April 22	Feb. 27–Mar. 25
Minnesota, Wisconsin, and Michigan	Mar. 14–May 5	April 4– April 18
North and South Dakota	Feb. 26–April 28	April 16
Idaho and Montana	Mar. 18–April 30	Mar. 19–Mar. 29
Manitoba and Saskatchewan	Mar. 26–May 9	
WEST COAST		
California	winters–April 2	Mar. 2–April 2
Oregon	Feb. 20–Mar. 23	Mar. 2–Mar. 4
Washington	Mar. 9–Mar. 22	
British Columbia	Mar. 22–April 25	Mar. 27
Alaska	April 21–May 8	April 28

Fall Migration Dates

		Peak
ATLANTIC COAST		
New York	Oct. 15–Nov. 15	
Maryland	Oct. 25–Dec. 10	Nov. 13–Dec. 6
INTERIOR		
Saskatchewan and Manitoba	Aug. 10–Oct. 20	
North and South Dakota	Sept. 1–Nov. 19	
Minnesota and Wisconsin	Sept. 10–Nov. 19	
Michigan	Sept. 10–Oct. 14	Sept. 26
Nebraska, Iowa, and Kansas	Sept. 15–Nov. 28	Oct. 15–Oct. 20
Mississippi, Arkansas, and Louisiana	Sept. 20–winters	Oct. 10–Nov. 25
Texas	Sept. 20–winters	Oct. 25–Dec. 10
WEST COAST		
British Columbia and Washington	Aug. 28–Dec. 14	Oct. 18–Nov. 7
Oregon	Sept. 2–Dec. 16	
Idaho	Sept. 30–Dec. 10	
California	Sept. 19–winters	Oct. 30

DOUBLE-CRESTED CORMORANTS

The double-crested cormorant is a large, dark water-bird similar in size and shape to a goose, but with very different habits. Cormorants usually migrate in flocks of 20 to 200 individuals, following the shoreline closely and generally staying below 1,000 feet. They are of concern primarily to airports in the immediate vicinity of the coast.

Dates of occurrence. Although the great bulk of the migration of any particular species passes a given point during a period of about 3 to 4 weeks in spring and 4 to 6 weeks in fall, scattered flocks or individuals occur several weeks earlier and later than the peak movement. The timing of the peak movement may be shifted a week or two if unseasonably warm or unseasonably cold weather prevails at the point of origin. The dates given in the figures cover the normal range of variation for the peak flights, but *do not* include the entire period during which small flights can be expected.

Migration—The flocks follow closely along coastlines (coastal bays and immediate offshore waters), river valleys, and water courses, even avoiding visible short-cuts. The outstanding exception is the overland route that many birds take in the fall from Boston Bay, southwestward across Massachusetts to coastal Rhode Island.

Spring Migration Dates

		Peak
North Carolina	Mar. 15–May 10	1st week April
Virginia and New Jersey	Mar. 21–May 22	3rd week April
Long Island	April 1–May 31	4th week April
Massachusetts and Maine	April 5–June 10	1st week May

Fall Migration Dates

		Peak
Maine and Massachusetts	Aug. 25–Nov. 1	September
Long Island	Sept. 1–Nov. 1	early October
Maryland	Sept. 10–Nov. 10	late October
Florida	Oct. 15–Dec. 10	

Flight—Cormorants usually fly at low levels, but may go up to 3,000 feet. They fly low over water, higher over land, and migrate both by day and night. The usual migratory flock contains fewer than 200 birds, but some flocks contain as many as 1,000.

AERONAUTICAL PUBLICATIONS

A list of publications of general operational interest to pilots is provided for your convenience. All are available from the Superintendent of Documents, Government Printing Office, Washington, D.C., 20402, except those indicated by asterisks, which can be procured from the Director, U.S. Coast and Geodetic Survey, Washington, D.C., and those that are free from FAA which can be requested from the FAA, Attn: HQ-438, Washington, D.C. 20553.

Airline Transport Pilot (Airplane) Examination Guide AC 61-18 (35¢)

Airline Transport Pilot (Helicopter) Written Examination Guide 1962 (30¢)

Airplane Flight Instructor Examination Guide 1962 (40¢)

**Alaskan Airman's Guide and Chart Supplement* ($9.00 first class mail from C&GS)

Basic Glider Criteria Handbook 1962 (75¢)

Commercial Pilot Examination Guide 1962 (65¢)

Facts of Flight 1963 AC 00-4 (50¢)

**Flight Information Publication (FLIP) Planning, Section I General Information DOD* ($3.75)

**Flight Information Publication (FLIP) Planning, Section II Aerodromes, Military Flight Procedures DOD* ($8.65)

**Flight Information Publication (FLIP) Planning, Section II-A Low Altitude High Speed Training Routes, Oil Burner and Refueling Tracks DOD* ($6.50)

**Flight Information Publication (FLIP) Planning, Section III International Rules and Procedures DOD* ($3.95)

FLIGHT TEST GUIDES:

- *Commercial Pilot—Airplane, Single Engine* AC 61.117-1A (10¢)
- *Glider—Private and Commercial Pilot* (15¢)
- *Gyroplane—Private Pilot* (15¢)
- *Gyroplane—Commercial Pilot* (15¢)
- *Helicopter—Private and Commercial Pilot* (15¢)
- *Helicopter Instructor Practical Test Guide* AC 61-14 (10¢)
- *Instrument Pilot—Airplane* AC 61-M (10¢)
- *Multi-engine Airplane Class or Type Rating* AC 61-4 (15¢)
- *Private Pilot—Airplane, Single-Engine* AC 61-5 (15¢)

Glossary of Air Traffic Control Terms (Free from FAA)

Instrument Flight Instructor Examination Guide 1962 (35¢)

Instrument Pilot Examination Guide 1964 AC 61-8 (40¢)

International Flight Information Manual ($1.00)

International NOTAMS ($3.00 Domestic) ($5.00 Foreign)

**Pacific Airman's Guide and Chart Supplement* ($5.75 first class mail from C&CS)

Path of Flight 1963 AC 00-5 (70¢)

Pilots Radio Handbook 1962 (75¢)

Plane Sense (Free from FAA)

Private Pilot (Airplane) Flight Training Guide 1964 AC 61-2A ($1.00)

Private Pilot's Handbook of Aeronautical Knowledge 1963 ($2.50)

Realm of Flight 1963 AC 00-3 (75¢)

Various Rules, Regulations, Orders, Technical Standard Orders (TSO), and Notices